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Our Power and Operating Section

IN this issue we begin a new departure in the interests of our readers. We publish a larger number than usual of articles relating to the generation and industrial utilization of electrical energy as well as to the installation and operation of electrical machinery of all kinds, grouped in a department designated as the "Power and Operating Section." These articles will be found particularly interesting to the engineers and operators in power plants who wish to acquire the latest information concerning the practical and more or less technical phases of their work. They will prove interesting and instructive also to men in charge of electrical installations in industrial plants, such as the engineers and electricians in manufacturing establishments, large office buildings and hotels as well as in the generating stations, substations and reserve plants associated with the large interconnected electrical distributing systems. The "Power and Operating Section," which will be published in each week's issue of the ELECTRICAL WORLD, will appear in greatly enlarged form in the second issue of each month.

The Thermophone

AN appliance of exceptional scientific interest, based on thermal action, was described in a recent paper before the Royal Society. As our readers are well aware, thermal action as a feature of certain telephonic apparatus has been known for a good many years. In fact, it was utilized in the days of Hughes and his contemporaries, and has been employed more recently in some of the forms of receiver used in connection with wireless telephony. The thermophone apparatus described in the Digest in this issue acts not by indirection but in immediate response to the varying heat supplied to a very small inclosed body of air by a platinum wire of extremely small diameter. It is, in fact, essentially a loop of platinum wire of 0.002 mm, or a little more, in diameter, inclosed in a small cavity under a tiny thin cover, the receptacle acting as a resonator for the variations in air pressure produced by the heating and cooling of the wire when receiving the telephonic variations of current. The whole receiver for telephonic purposes may be slipped into the orifice of the ear, and from all reports operates exceedingly well in spite of its small dimensions. The general theory of the instrument has not been worked out at all accurately, but it is known that the acoustic effect varies approximately as the square of the current strength and the variations of heating take place isochronously with the vibrations in the transmitting microphone. It is a beautifully simple application of thermal action to telephony, and while the principle is by no means new, it has been applied in the present instrument in a very striking and efficient fashion.

Damage by Short-Circuit

A SHORT-CIRCUIT in a cable is not an uncommon happening in every-day electric service. On Wednesday of this week the splendid rapid transit subway system of New York with its daily traffic of over a million was completely shut down from such a cause. Many passengers were overcome by the fumes of burning insulation, and as a consequence suggestions have been made that some form of fireproof insulation be demanded. The cables damaged by the short-circuit were insulated in accordance with standard practice, and like the rest of the Interborough system were maintained in good shape. However, no insulation can withstand a short-circuit maintained by generators capable of supplying many hundred thousand kilowatts to it. The temperature of such an arc is high enough to melt asbestos, stone, porcelain or any other substance having any insulating value whatsoever. It is apparent, however, that no cable vault or manhole subject to such mishaps should open or communicate in any way with a subway of such importance. Separate and distinct entrances will without doubt be provided hereafter for such manholes.

New York Commissions

THE subway fire in New York this week has given an unexpected momentum to the movement of the Republicans for reorganization of the Public Service Commissions. Since Mr. Whitman was elected Governor there have been reports that the Republican party plans a new law abolishing the two present commissions and creating in their place one commission with authority throughout the State. The first definite public act confirming these reports is the introduction of a resolution in the Legislature on the day of the subway fire providing for an investigation of that occurrence and of the commissions. Undoubtedly the causes of the fire will be investigated, but it is the commissions that are the real target. Governor Whitman and his party are undertaking a grave responsibility, and it is highly important that their action shall be for the best interests of the State as a whole, and not for the advancement of political fortunes. The first appointments made by Governor Hughes to the commission in 1907 were free from political taint. Succeeding Gover-

nors appointed politicians for political reasons. The public interest needs able, competent and impartial men having the public good as their sole aim. Political appointments to a public utility regulating commission, if persisted in, are sure to cause the ruin of the policy of regulation to which the country is committed. Governor Whitman is in duty bound to see to it that regulation in New York is taken out and kept out of politics.

A New Illuminometer

Within the last few years the requirements of illuminating engineering have produced a considerable number of illuminometers, or more precisely portable photometers adapted to illumination measurements. In an article in the current issue is described the latest of these, the Macbeth instrument, the result of considerable study on the part of an experienced illuminating engineer, and as such a welcome addition to the line of portable instruments. All portable photometers consist essentially of three elements, a standard of light, a means for varying the intensity of the illumination derived from that standard, and a photometer screen enabling the instrumental illumination to be balanced against that received from the outside. Speaking in general terms, the only serious difficulty resides in the portable standard of light. No trouble whatever is experienced in obtaining a good photometric screen, any one of many well-known forms of photometer screen being capable of sufficient accuracy for all illumination measurements. This part of an illumination photometer may therefore be considered as involving no technical difficulties when reducing the instrument to a portable form. Likewise there are divers thoroughly practicable means for varying the illumination on the instrumental side of the screen.

The Macbeth instrument represents the result of a commendable attempt to solve the problem of developing an accurate portable photometer. It consists essentially of a Lummer-Brodhun prism used as a photometer screen, a working standard operating by varying the distance from the instrumental screen, and a standard lamp held at constant value by means of adjustable resistances, used in connection with a storage battery. Like other instruments of its class, it may be used either with an attached or a detached test plate as circumstances may make desirable. Its notably unusual feature is the provision of a primary standard lamp furnishing light to a test plate with which the working standard can be compared from time to time, a feature of obvious convenience. Such a device is useful in reducing the personal equation which results from different habits of balance, since the observer uses the primary standard by the method of substitution in the field. In cannot, of course, eliminate the personal equation resulting from color difference any more than would be possible in a photometer room calibration by the same observer; however, a set of screens for dealing with color difference is provided to reduce trouble from this source. Altogether, it looks like a very useful addition to portable photometric equipment.

Difficulties with all such instruments reside in the necessary complications in obtaining suitable values for the working standard. Attempts have been made in several foreign illuminometers to reduce these by eliminating the measuring instrument and depending on the constancy of voltage of the storage battery which furnishes current during the period in which the photometer is in use. This procedure is sufficiently successful, provided that the instrument is regularly so employed that the storage battery is always kept in its best working condition. Under these circumstances an instrument may be used for an evening without appreciable error, but if used only occasionally it is safe to assume that the storage battery will not be in prime condition, and there is a likelihood of introducing considerable errors. The device for calibrating the Macbeth instrument in the field by means of a subsidiary primary standard appears to be very useful when the illuminometer is to be employed for periods of some length, and it really constitutes its distinctive feature.

Protection Against Over-Pressure

In an important article abstracted in the Digest in this issue Mr. Kenelm Edgcumbe discusses at length protective gear for dealing with the abnormal pressures, whether of external or internal origin, which occur in high-tension circuits. Such disturbances he divides into two classes—first, those due to causes external to the system and including so-called static discharges and those associated in one way or another with lightning, and, second, abnormal rises of potential due to direct resonance, to the violent electromagnetic disturbances occurring at sudden changes of load and the miscellaneous group associated with partial stationary waves at points of electro-dynamic discontinuity, and similar phenomena. The essential difference between them, as he points out, is that the external disturbances, and particularly the severe ones associated with lightning, are very sudden, involving extremely steep-fronted waves and sometimes high frequencies. It used to be believed that lightning was ordinarily a high-frequency disturbance, but more recent studies have led to the conclusion that the dimensional limitations imposed by the capacities and resistances involved in lightning discharges are such that one usually deals with a discharge which may be regarded as of high frequency only in virtue of its having a very steep front, and such high-frequency oscillatory action as may be noted is usually of very minor magnitude. Internal disturbances, on the other hand, although sometimes of most formidable character, do not cause enormously steep wave-fronts, but rather those corresponding to the moderate frequencies of the system. Hence the means adopted for dealing with these two classes of phenomena are necessarily somewhat different.

Mr. Edgcumbe analyzes the performance of various classes of apparatus designed to protect against external disturbances. Both in theory and in experience grounded wire commonly used as a protective device is useful, but it is a palliative rather than a cure, and the

protection of apparatus must still be insured by other devices. As is well known, lightning discharges have a strong tendency to puncture the external turns in transformer windings and the like, and may produce very serious damage. Of the various devices used for protection Mr. Edgcumbe has no very flattering opinion, with the exception of the choking coil, which he aptly compares to the removal of the external turns of a transformer and their establishment in such form that they cannot readily be damaged and will provide for discharge to earth. Of the discharging devices he is rather inclined to rely on the horn-gap in series with a carbon-powder resistor. He has a good word, however, to say for the aluminum lightning arrester which is so largely used in this country, his only objection to it being based on the care required, which renders it suitable for station work rather than for general application. Resistance rods and liquid resistors he holds in very small esteem. With respect to "static," another well-known form of external disturbance, Mr. Edgcumbe pins his faith on a permanent high-inductive resistance to earth as the best remedy, a device not yet widely used, at least in our own country. Obviously it is capable of carrying off a purely static rise of potential, but we are inclined to think that what is commonly known as "static" is often of a different character and may be handled by the ordinary protective devices.

With respect to the internal disturbances the situation is different. The discharges produced are less sudden, but the amount of energy to be dealt with is often very large. Resonance of the fundamental frequency, except under particular circumstances on very long cables, is extremely unusual, but resonance of the harmonics may easily occur and lead to serious results. He specially mentions the harmonics of considerable amplitude which may arise when a short-circuit occurs on one branch of a three-phase line with resulting resonance in the other phases. Another group of troubles from over-pressure is familiar as arising from sudden switching on or off of circuits containing inductance or inductance and capacity, and formidable voltage rises now and then occur too on an unloaded line from cumulative reflected waves. Fault between lines or line and earth may lead to over-pressure in a way analogous to switching operations, and in most plants the danger from the inside is considerably greater than the danger from the outside. The amount of energy to be dealt with is commonly quite too great for the apparatus installed readily to endure, and every one with experience in such matters can recall instances where devices installed for protective purposes have been literally blown to pieces by the concentration of energy upon them in the discharge. Mr. Edgcumbe advocates the use of the horn-gap with a suitable carbon-powder resistor as, on the whole, the most reliable and generally efficient means of protection. He does not at all share the fear of many engineers that breaking the arc at a horn-gap may produce considerable disturbance on its own account, basing his opinion on various oscillographic determinations of the conditions. We are hardly inclined to agree broadly with his view of the case as considerable evidence to the contrary has been accumulated in this country. Yet the horn-gap has elements of dependability that have brought it into large use. Our own view is that a good deal remains to be done in protection against surges, the horn-gap advocates to the contrary notwithstanding.

The protection of systems including both cables and overhead lines affords the most serious problems in relation to both internal and external disturbances, and although many palliative measures have been somewhat successful, every operating engineer can call to mind a long series of apparently inexplicable failures, some of them producing results of extreme gravity. Only long and patient study of the conditions, with frequent help of the oscillograph, is likely to clear up the difficult question of protection. We earnestly advise, however, a careful reading of Mr. Edgcumbe's article, as it gives a capital presentation of the phenomena in their general relations.

The Rumford Falls Power Station

The hydroelectric plant on the Androscoggin River at Rumford, Maine, represents a capital example of the reorganization of an old plant for higher efficiency and greater output. The hydraulic site was utilized long ago, on one of the most reliable streams in the East, the Androscoggin River being the outlet of the great Rangeley Lake group, in which the flow is well regulated. Rumford is largely a town of paper mills; in fact, it is one of the most important centers of this industry in New England. Hence a large part of the power developed is devoted to the paper industry. Originally of modest output with belted units, the plant has been improved from time to time and has now undergone an important reconstruction. By a dam some 400 yd. above the station the river is diverted into a canal which provides a working head of approximately 100 ft. for water for three turbines, two of 5000 hp each and one of 2700 hp. As a protection against the cold weather the penstocks, which are of steel, are sheathed with inch boards, this protection being increased near the station by felt and asbestos roofing.

The energy supplied by the plant is in part sold at the station to the local central-station organization but in the main is delivered to the large paper mills in the town. Energy is distributed at 11,000 volts in order economically to reach the scattered paper mills. These are supplied through 2300-volt substations. A part of the energy in the various mills is delivered in the form of 220-volt direct current from motor-generators for operating the variable-speed motors necessary in driving some of the machinery. Much of the load extends over the whole twenty-four hours, so that the plant has an abnormally high load-factor, reaching in fact the probably unique figure of 90 per cent. The total yearly output for this reason is astonishingly great for a plant of its magnitude, reaching 40,000,000 kw-hr. annually. The present plant is the result of intelligent evolution, and the changes made in it have greatly increased both the output and the efficiency.

LETTERS TO THE EDITOR

Safer and Cheaper Wiring Systems

To the Editor of the ELECTRICAL WORLD:

SIR:—That there is a demand for cheaper wiring methods no one can doubt; the suggestion of using a bare concentric grounded system should bring about the desired result. I have long advocated the mandatory grounding of secondary alternating-current systems, and I believe that the use of the bare concentric system will hasten the day of universal grounding. I am interested in this subject primarily because of the additional safety which its use insures and also because of the lower cost of installation. When this system is properly installed and when polarity extension plugs are used it will be an absolute impossibility for a person using electric light to receive an accidental shock of any kind. Not only will it be impossible for him to get a high-potential shock but he cannot get a shock at 110 volts unless he does it deliberately by putting a screwdriver into the center of the lamp socket while holding on to the outside of the socket or by other similar means.

If such a system can make electric-lighting circuits perfectly safe and at the same time reduce the cost of installation, then there is every good reason why it should be encouraged. The demand for increased safety and for cheaper construction comes directly from the electric-lighting companies and no manufacturing interest is in any way responsible for it. I am informed that the patent situation is such that any manufacturer in this country is free to make the wire. Detail patents on the fittings can be and probably will be obtained by the different manufacturers, but the field is open, and all wishing to enter have an equal show.

The sub-committee of the National Fire Protection Association, of which I am chairman, has made a first draft of rules covering the installation of the system, and a revised set of rules undoubtedly will be brought out in the very near future. The committee's final draft will be printed in the "Bulletin" sent out by the N. F. P. A., will be distributed broadcast and will be considered at the March meeting when other proposed changes in the Code will also be considered. I feel personally that honest criticism at this time is most desirable and should be welcomed by all interests. If the concentric wiring system has merit, it will undoubtedly be adopted; if there are serious objections, these objections will be brought out. There are no interests more vitally concerned in safe wiring than the central-station companies, and if this proposed system is to add any hazard the electric-lighting companies will be the first ones to demand that the system be set aside.

From the account which I read in the ELECTRICAL WORLD it would seem that the electrical manufacturers, jobbers and contractors who met in New York on Dec. 22 feared that the use of this system might be authorized before the electrical interests would have time to adjust themselves to the change. On this subject I would say that no action will be taken on the matter until March, 1915. If the rules as presented by the sub-committee of the National Fire Protection Association carry, the use of the grounded concentric system will not be mandatory but will be permissive and subject to the "approval of the inspection departments having jurisdiction." There will be no desire on the part of any member of my committee, I am sure, to force the immediate use of this system, and a delay of six or nine months, or even a year, might very properly be made to allow manufacturers and jobbers time in which to dispose of their present stocks. It will take the manufacturers, I am informed, six months or more to get out any appreciable amount of wire or to develop lines of fittings which would be applicable to this system. This whole matter, I believe, is in the line of progress and will tend greatly to increase the business of manufacturers, jobbers and contractors. I had personally feared that it might temporarily decrease the sale of the smaller sizes of conduit and of metal molding, but one of the largest jobbers in the country assures me that he fears nothing of the kind and thinks that his business will be materially increased and that the sale of lamps, sockets, heating devices, electric fans, etc., will be stimulated.

Any step which can be taken to popularize the use of electric lighting will not only be of advantage to the central stations, the manufacturers, the jobbers and the contractors, but will also meet the approval of the Underwriters and be appreciated by the general public. If the grounded concentric wiring system is a good thing, let us do everything we can to make its use permissive; if it has any dangerous aspects, let us find out what they are and see that they are eliminated before the system is allowed to come into general use.

Boston, Mass. W. H. BLOOD, JR.

Cheaper House Wiring

To the Editor of the ELECTRICAL WORLD:

SIR:—In connection with the article in your issue dated Dec. 12, 1914, entitled "Cheap House Wiring," by Mr. W. H. Blood, Jr., N. E. L. A. insurance expert, attention should be called to patents Nos. 645,011 to 645,015, issued on March 6, 1900, to Messrs. Warren B. Reed and Lyman C. Reed. Their patents cover not only a system of interior wiring such as described by Mr. Blood but also the detailed methods for distributing the energy from the generator to the appliances.

To those who fifteen years ago solved the problems involved, it is gratifying to learn, even at this late date, that the engineers of the National Electric Light Association are considering this distributing system seriously, although we labored in vain for its acceptance by those wielding the destinies of the insurance hazards in this country.

The writer suggests that all engineers now having the matter under consideration obtain copies of the above-mentioned patents, which contain much information concerning the entire field of electrical distribution.

New Orleans, La. WARREN B. REED.

[Of the five patents issued on March 6, 1900, to Messrs. W. B. and L. C. Reed, the first in date of application (Sept. 13, 1899) related to an underground system of electrical distribution in which the neutral conductor cable of a three-wire system of distribution is dispensed with and the metallic sheathing of the cable is utilized in its stead. The sections of sheathings are permanently bonded and grounded at all available points of the system, thereby producing a neutral equal in practical effect to one of infinite cross-section. The second patent related to the application of this principle to overhead wires, the third to the series-arc system of electrical distribution, the fourth to alternating-current transmission and distribution, and the fifth to electric-railway feeders. In the latter case the sheathing, which is insulated from the interior conductor, is grounded at every available point and connected to the rails wherever practicable.—ED.]

Concentric Wiring

To the Editor of the ELECTRICAL WORLD:

SIR:—Referring to the article on "Cheaper House Wiring" and its discussion at the meeting of manufacturers and contractors at the Hotel Biltmore, New York City, on Dec. 21 (see ELECTRICAL WORLD, Dec. 26, 1914), it is a matter of great regret to the writer that Mr. Luther Stierenger, who had so much to do with the development of safety methods and devices for incandescent wiring, could not have been present at the meeting to have told us something of the earlier development in methods, devices and safeguards which it is now proposed to "chuck overboard," apparently with very slight consideration. One of the speakers at the meeting mentioned stated that the changes proposed would mean going back twelve or fifteen years. Possibly the speaker's experience did not enable him to tell the entire truth, which is that it would be going back about thirty years or more. The Mills Building in New York was the first building of importance wired for incandescent lighting during the construction of the building. This work was done in 1881-1882. At the same time numbers of old buildings in the old Edison-Pearl Street district, in New York City, were being wired.

At this time only single-pole fuses and single-pole switches had been designed. Switches and fuses were placed on one side of the two-wire system throughout, beginning with the central-station switchboard. This arrangement made it possible to test and keep one side clear of grounds, locating the grounds which occurred by disconnecting sections at the fuses and switches. Therefore we had practically a grounded system, as little effort was necessary to keep the continuous line free from grounds.

Insulating joints had not been thought of, or at least had not been made. It is worth while to compare the material, the methods and the workmanship which have been developed to-day in incandescent lighting with the lack of perfection found in the early style of work.

It seems like a curious bit of inverted logic to speak of using grounded circuits or earth return for incandescent lighting to-day. In every kind of electrical distribution grounded circuits and earth return have been attempted, invariably with inferior results. For a generation at least earth return has been used on all telegraphic lines. To-day metallic circuit is used for telegraphing, at least for the more important lines. Early telephone work was all done with grounded circuits. To-day only a small portion of this remains, practically all telephoning being done with continuously insulated metallic conductors. On all of the earlier electric-railway systems earth-and-rail return was employed. The troubles resulting from each were so numerous and so serious that every effort has been made to get away from the grounded circuit, some cities, for instance Cincinnati, forbidding absolutely the use of earth return, in spite of the great difficulties involved in the use of complete metallic circuit in connection with a moving contact.

Iron ships appeared to offer an ideal opportunity for the one-wire system by using the steel skin of the ship for return, and many ships have been wired in this way. I am not really posted on the history of ship wiring, but believe that the one-wire system has been practically abandoned in favor of the completely insulated metallic copper circuit, and I have no doubt that the cause of this would be found in the frequency with which faults would develop where only a single thickness of insulation interposed between the ground return and the copper conductor. A ship is not the place to take the risk of fire. We are told that with the concentric conductor exposed wiring may be permitted, and that the concentric wire with bare copper conductor outside can be run on the wall and ceiling and papered over, etc. Now there is no doubt that this arrangement can be made to work very nicely for a while, but those of us who have been in the incandescent-lighting business for more than a few years have a realizing sense of the time element. Many things which work very beautifully for a short while subsequently work very badly, and one of the insidious troubles which develop at times in geometric ratio is electrolysis. Dampness is encountered everywhere, incidental, accidental, varying with weather, with time and with local accidents. The concentric two-wire conductor, with conducting copper exterior, will suffer from continual electrolysis, even with a very slight degree of dampness and even though the insulation on the inside wire is perfect. Wherever current flows there is a voltage drop from point to point. This difference will be slight but certain in the interior of a single building. It will be certain, and not so slight, between different points in a large distributing system. The concentric wire, which is so neatly concealed by the paper-hanger, will develop various kinds and degrees of discoloration, according to the degree of dampness and the material present for the current to work upon. The discoloring in electrolysis will mean actual metallic corrosion, and this may in time lead to the severing of the outside conductor and to heating and arcing, which in some situations would mean a serious fire risk, even though the insulation of the central conductor had not suffered in the least.

I do not think it has been pointed out that with a single insulating sheath a larger quantity of insulation would be required actually than with two separate insulating sheaths. It has not been proposed, so far as I know, to lower the voltage in connection with a grounded concentric wiring system. Therefore, with the same voltage as before the same thickness of insulation on the wire will be needed in order to prevent an undue number of failures. As cross-sectional area and weight vary with the square of the radius, the single wire, with double thickness of insulation, will require an additional weight of insulation. The expense of the added insulating material will be worth considering.

It seems pertinent to ask why American electrical engineers should go to Europe for improvement in incandescent lighting applications. Many good things in the way of scientific development and new discoveries have come from Europe, but in the electrical distribution of energy the United States is so far ahead that we feel a sort of pity for the European lighting engineers when we see how badly they do many things; most of all, when we see how badly they do interior wiring. We are certainly many years in advance of Italy, France and England in methods and material for interior wiring. It is true that we build our houses to burn up, whereas most European buildings are reasonably safe from danger of fire. Still, it is a fact that in our most modern and perfectly fireproof office buildings and public buildings we have not found it desirable or necessary to be less particular in regard to wiring devices and methods. In fact, in our large buildings, which we claim contain not enough wood to make a lead pencil, the wiring will be found to be as conscientiously done according to fire insurance rules as in cheaper and poorer buildings.

The irritation produced by the red tape and fussy methods of our fire insurance wiring rules is largely cured by an inspection of wiring methods in Italy and

England, where no such rigid authority exists and where such rules and inspection as are made are of governmental origin and enforcement. In England the concentric wiring system of Andrews has been carefully developed but has not been largely used, probably on account of the difficulty in making joints and connections. It would seem to have been very perfectly worked out in detail and ought to be satisfactory in use if installed by skilled workmen.

The writer feels like urging very strongly caution in making sweeping changes in our present wiring methods. We have arrived at a high degree of excellence by going slowly and taking short steps and by trying out each improvement before demanding change. We have the very great advantage of central authority over the whole United States, as compared with local authorities.

The work of the Underwriters' Laboratories has been of great educational value to both the manufacturers and the contractors. We should like to see the committee on rules of the National Board of Fire Underwriters and the skill and facilities of the Underwriters' Laboratories broadened and strengthened until they would command the confidence of every educated engineer. This result would be hindered by any bad mistake, such as the promulgating of hastily considered rules.

Philadelphia, Pa. CHARLES WIRT.

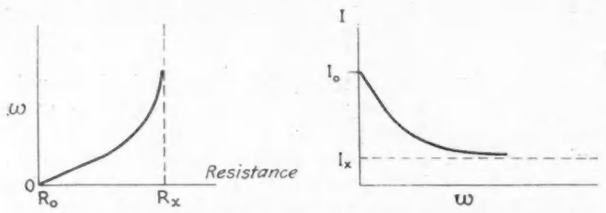
The Photometry of Gas-Filled Lamps

To the Editor of the ELECTRICAL WORLD:

SIR:—Coincident with the commercial success of the high-efficiency tungsten lamps new difficulties have been presented to the science of photometry. In consequence of the adoption of this lamp for standard illumination practice it has become necessary to make standards with which to compare the commercial product. In studying the general principles which were employed in the construction of these lamps when first placed on the market, I realized that certain difficulties would arise when it became necessary to obtain their photometric constants for the purpose of making standards for comparison. The photometrical difficulties which will be encountered in making these standards and in the subsequent comparison with the commercial product are, I believe, not generally recognized.

It is common practice in photometrical laboratories to measure the constants of a lamp while it is rotating, the speed of rotation varying from approximately 80 to 120 r.p.m. When a high-efficiency lamp is burned in a stationary position there are definite constants for current, voltage and candle-power which will satisfy the operating equation for any given lamp. (Owing to the distortion of the filament, from its expansion on heating, the constants of the lamp are not absolute, and changes in the current and the candle-power in a particular direction, will not be uncommon. By careful selection of lamps and proper orientation this difficulty may be partly overcome.) When the lamp is rotated two primary opposing phenomena take place, and perhaps several secondary phenomena, to affect the constants of a lamp more or less perceptibly. The filament changes in resistance because of its mechanical construction. The filament of the lamp is made up of several loops of a helical spring of tungsten wire. When an angular velocity of ω is imparted to the filament a force dF equal to $\frac{\Delta w \omega^2}{g} r$ is imparted to an elementary particle of the filament. The direction of this force is such as to cause the filament to lengthen in direct proportion to the square of the angular velocity for limited values of ω. The ratio $\frac{dF}{dl}$ approaches infinity as a limit for comparatively large values of ω (dl is the change in length of the filament due to the force dF). Owing to this stretching action of the filament when rotated, there is attained a condition the characteristics of which is expressed by the general curve shown in Fig. 1. As the angular velocity increases the values of the resistance become asymptotic to a limiting resistance R_x. Such a phenomenon would cause the current characteristic of a high-efficiency lamp to assume the conditions shown by the general curve of Fig. 2, where I_o is the value of the current when the lamp is stationary. The current becomes asymptotic to the value I_x for increased values of ω.

The counter primary phenomenon is the increased cooling effect on the filament due to the rotation of the lamp. This cooling effect would be produced by the action of the air external to the bulb on the periphery of the bulb. This action would accelerate the dissipation of heat from the glass surface, and consequently the filament, approximately as $\omega^{1/3}$. The convexion currents within the bulb would suffer little change due to the low viscosity of nitrogen and the low values of ω used in practice.



FIGS. 1 AND 2—CURRENT CHARACTERISTICS OF LAMP

Thus two primary effects are produced by rotation of the lamp. For the first phenomenon the current would vary approximately as $\frac{1}{\omega^2}$ and for the second primary phenomenon the current would vary approximately as $\omega^{1/3}$. It is evident that there will be a critical value of ω for which the current will equal the stationary value I_o.

The combined effect of the two primary opposing phenomena would lead to different values for the critical value of ω, depending on whether the lamp is rotated with its tip up or tip down, due to the change in the conduction constants of the lamp in the two different positions.

On account of the lack of suitable apparatus, an extended study has not been attempted by the writer. It is hoped, however, that by calling attention to the above principles interest may be awakened to such an extent that some of the well-equipped photometrical laboratories will undertake a research which will develop equations connecting the constants of a high-efficiency lamp with the speed of rotation and determine analytically and experimentally the exact nature of the reactions that take place to produce the variations in the constants of a high-efficiency lamp when operated at various speeds of rotation.

Washington, D. C. DAVIS H. TUCK.

[The manuscript for the above discussion reached us practically simultaneously with the manuscript of the article by Messrs. G. W. Middlekauff and J. F. Skogland relating to the same subject, published in the ELECTRICAL WORLD dated Dec. 26, 1914, but could not be used in that issue on account of the extra time required for preparing the illustration.—ED.]

FIG. 1—HYDROELECTRIC DEVELOPMENT OF RUMFORD FALLS POWER COMPANY

Hydroelectric Development at Rumford, Maine

Utilization of Flowage of Androscoggin River at Falls—Central-Station Energy for Paper-Making and Chemical Plants

THE electrification of the Androscoggin River at Rumford, Maine, affords an interesting example of water-power utilization. As the outlet of the famous Rangeley Lakes this stream is an exceptionally reliable power producer, with a minimum flow conserved by the Aziscohos dam in the lake region, built a few years ago through the co-operation of the Rumford Falls Power Company, the Union Water Power Company, the Berlin Mills Company and the International Paper Company, all users of power on the river in New Hampshire or Maine. Rumford, a thriving industrial town of 7000 inhabitants, is one of the chief paper-making centers in Maine. Here are situated mills of the International Paper Company, the Oxford Paper Company, the Continental Paper Bag Company, the Maine Coated Paper Company and the Fort Hill Chemical Company, all being substantial power users. With the exception of the first-named concern, all are customers of the Rumford Falls Power Company, whose general hydraulic development is illustrated in the headpiece on this page.

The station has passed through an evolution in which belted units have yielded to directly connected outfits; the head utilized has been increased to 100 ft. and the station rebuilt along modern lines which give little evidence of the changes effected from time to time. As the flow of the river exceeds that necessary to the present development, and as the latter has reached its maximum with the present station, 9750 kw, the power company plans ultimately to build a new station a short distance downstream, with a total rating of 24,000 kw in six generating units.

About 1200 ft. above the station the river is diverted by a timber and rock-fiilled dam 250 ft. long, which backs up the water for 8 miles. Approximately at right angles to the dam a retaining wall 60 ft. from the cliff forms with the cliff wall a canal about 100 ft. long and 18 ft. deep. At the lower end of the canal double sets of racks are provided, and behind these is a narrow forebay with two sluicegates on the river side and two main gates on the downstream side, with connections to two steel penstocks leading to the power house. The gates were built by the Holyoke Machine Company, Worcester, Mass., and are shortly to be equipped with motor drive, hand operation at present being employed. Vent ducts are provided in the concrete wall carrying the gates, and provision is made in the shape of vertical pipes surmounted by funnels through which hot water can be poured to keep the vents free from ice. Galvanized iron guards are installed over all gearing to prevent ice formation.

Station Equipment

In the generating plant are one 2700-hp and two 5000-hp Holyoke horizontal turbines directly connected to the main generators, all of which are Westinghouse 2300-volt, three-phase, revolving-field alternators, making 400 revolutions per minute and delivering sixty-cycle energy to the switchboard through cables carried in floor ducts. To the smaller turbine are directly con-

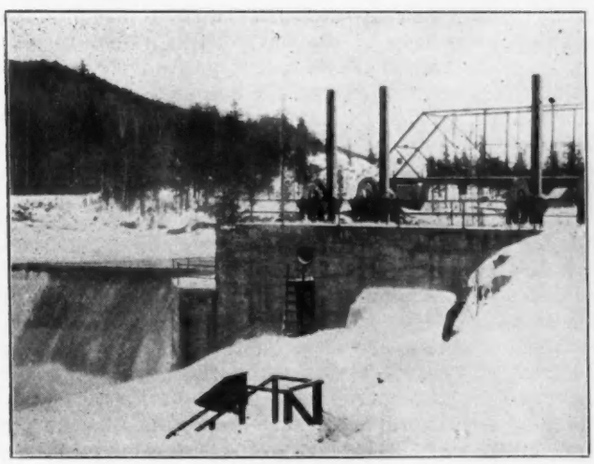


FIG. 2—DAM AND HEADWORKS

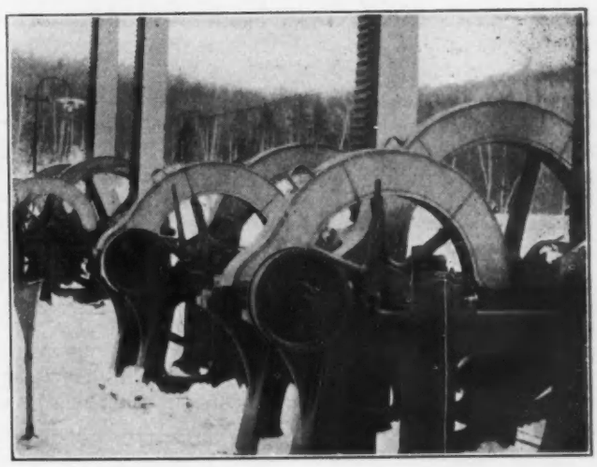


FIG. 3—GUARDS OVER GEARS AND FUNNEL CONNECTIONS

nected three generators of 400-kw, 550-kw and 800-kw rating respectively, these machines having been used in the earlier station construction and being equipped with shaft couplings, with a 10-kw directly connected and a 45-kw belt-driven exciter running at 900 r.p.m. The two larger wheels each drive a 4000-kw generator, one being equipped with an 85-kw belt-driven exciter running 725 r.p.m. Between the larger units and the smaller set is a 100-kw exciter directly driven by an independent waterwheel. These machines are mounted in a row in an operating room 200 ft. long by 30 ft. wide and 17 ft. high. The station is of brick and concrete construction, the penstocks being brought down to the roof and carried vertically to the wheels as shown in the illustrations.

One penstock is 13 ft. in diameter and is carried through to the 4000-kw unit nearest the downstream end of the station. The other is 14 ft. in diameter, being carried through in this size to the second 4000-kw unit, with a 10-ft. branch leading to the 1750-kw three-generator unit and a 3-ft. branch supplying the independently driven exciter. Double-draft tubes lead from the wheel casings to the tailrace. The penstocks are supported on masonry piers, and each of the main pipe lines is provided with a full-diameter branch leading to a relief outlet carried in the middle of a concrete inclosing structure provided with steps and runways for the discharge of the spilled-over water into the river without damage.

Below the station a canal is utilized by the International Paper and Fort Hill Chemical companies, the discharge from local wheels in these mills being conducted to a second or lower canal utilized by the Oxford company, with final discharge into the river below the town. A total fall of 180 ft. is utilized in the town, including that of the power company's plant. The penstocks are covered with 1-in. wooden sheathing at present throughout a large part of their lengths, the runs close to the station being further protected from cold weather by woolen felt and asbestos roofing. The Holyoke Machine Company's "Improved" governor is used, and the gate openings on each wheel are recorded on Barrett and Lincoln hydro-chronographs.

System Control

The main switchboard consists of twenty-one marble panels mounted on the floor of the operating room near the northern end of the station, machine cables being run to it in floor ducts, with generator oil switches of the hand-operated type at the rear of the panels. All the energy sold by the local central-station organization, the Rumford Light & Water Company, is metered at this board and the distribution is by 2300-volt, three-phase circuits run down the valley on a wooden frame pole line. A No. 6 arc circuit is also run from the station, supplying 6.6-amp alternating-current inclosed-arc lamps, but a trial installation of nitrogen-filled lamps is being made for street illumination, with the prospect of its early extension. All switchboard panels are provided with knife switches at the top, by which they may be disconnected from the buses when necessary. A single set of buses is installed, and the feeder oil switches are mounted in a fireproof compartment on the roof. A noteworthy feature of the board is the extended use of recording instruments, both Bristol and Westinghouse outfits being installed.

A separate panel is provided for the station heaters, the entire plant heating being by electrical energy. For this service twelve Simplex grid-type heaters are installed, each consuming 7.2 kw at 110 volts and being controlled by a separate switch on the heater panel. Graphic ammeters are used on the circuits supplying the light and water company, on the outgoing power lines and on the station auxiliary service lines and totalizing panel, graphic wattmeters being used on the Light and Water service and on the generator totalizing panel. Graphic power-factor and frequency meters are used on the totalizing generator panel. The synchro-

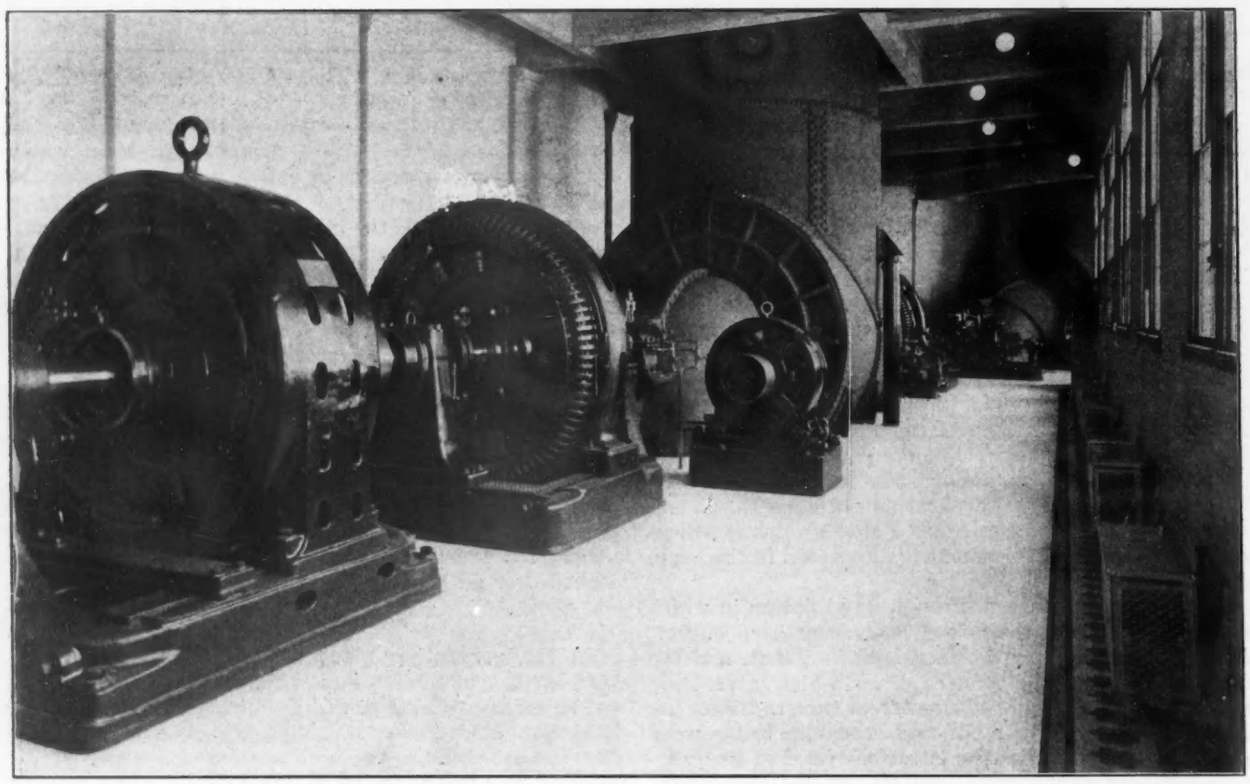


FIG. 4—SMALLER UNITS IN RUMFORD FALLS POWER COMPANY'S PLANT

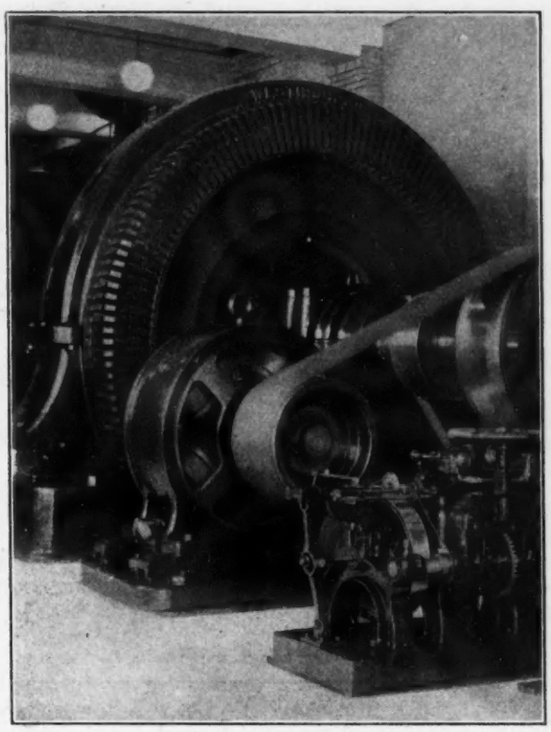


FIG. 5—4000-KW GENERATOR

FIG. 7—ENTRANCE OF PENSTOCK TO ROOF

scope, power-factor indicator and voltmeters on the usual bracket at the end of the board are illuminated by two 25-watt tubular lamps carried in horizontal reflectors concealing the lamps from the floor level. Recording wattmeters are also provided along the usual lines of practice.

The station lighting is by twenty-nine units hung 15 ft. above the floor of the operating room, each consisting of an Alba globe 14 in. in diameter containing four 40-watt lamps. The station is provided with a tile floor, pressed-brick walls and smoothly finished concrete ceiling. The heaters are carried on angle-irons with 14-in. by 18-in. arms from 1 in. to 3 in. thick and attached to the wall by a ⅜-in. bolt at the top of the angle in each case, the heater being mounted 10 in. above the floor and usually under the window. No

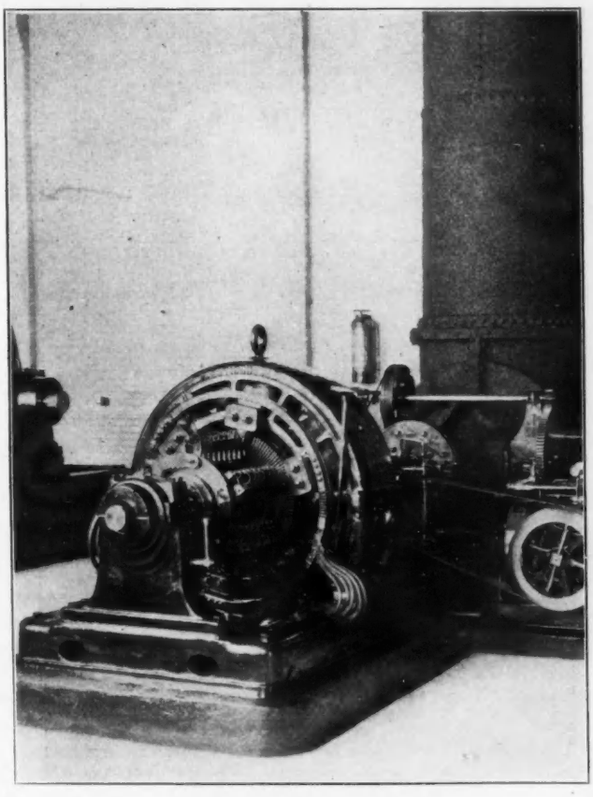


FIG. 6—100-KW EXCITER

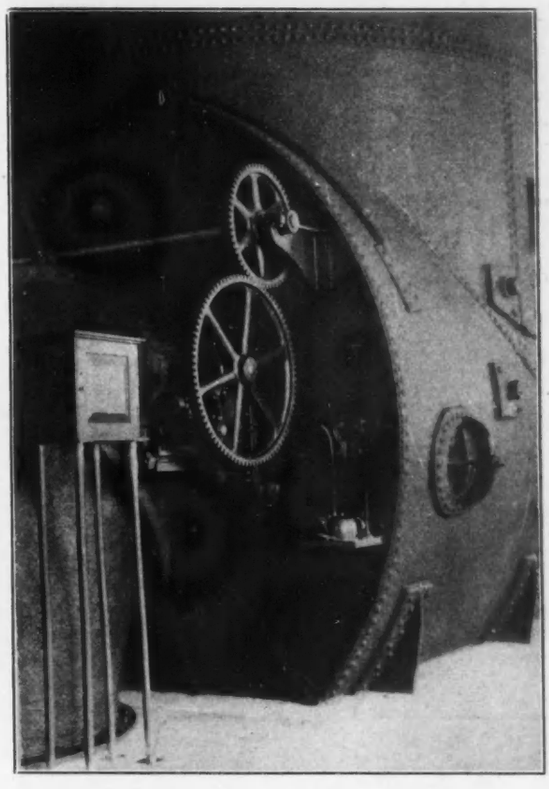


FIG. 8—HYDROCHRONOGRAPH CONNECTIONS AT WHEEL

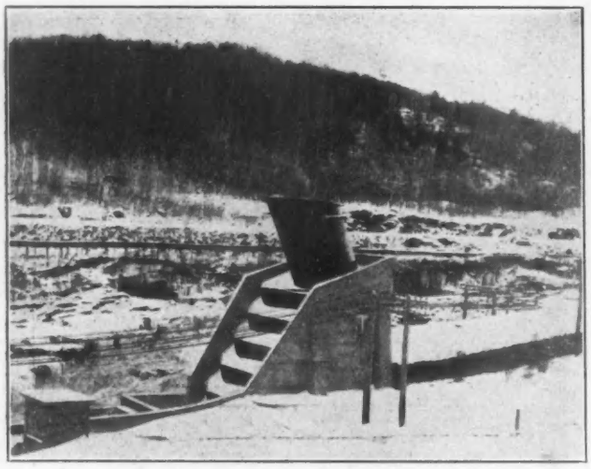


FIG. 9—RELIEF PIPE AND SPILLWAY

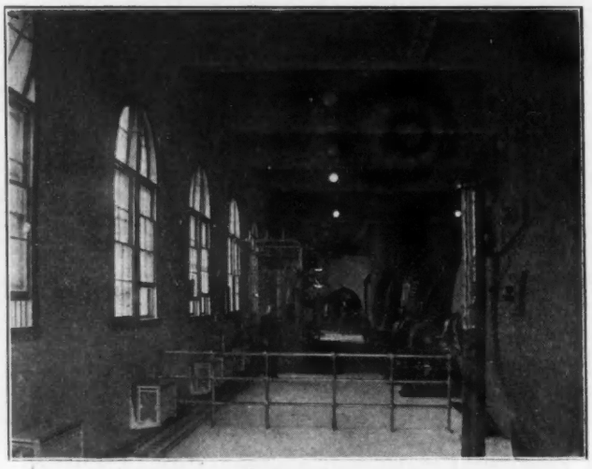


FIG. 11—OPERATING ROOM

steam heat is employed in the building, and the vitiated air is removed by two motor-driven fans controlled by starting boxes on the main switchboard. A small machine shop is installed just outside the operating room, and the chief operating engineer's office, which is reached by a winding stairway leading from the shop, and the walls are utilized for the storage of supplies of small size, steel shelves and racks with unit sections having been provided for this purpose. On account of the arrangement of the penstocks, the station has no fixed traveling crane, but machinery is handled by a traveling hoist which is assembled upon a frame of 10-in. and 12-in. steel I-beams when work of this nature has to be done, the capacity of the hoist being 5 tons. When not in use the members of the frame are stored under a shelf at the side of the operating room.

Distribution System

The outgoing feeders are dead-ended by turnbuckle connections and strain insulators in a wire tower shown in the general view of the station, each line being provided with a choke coil and lightning arrester connections carried on a wooden and steel frame about 10 ft. above the floor. An insulating section cut into each

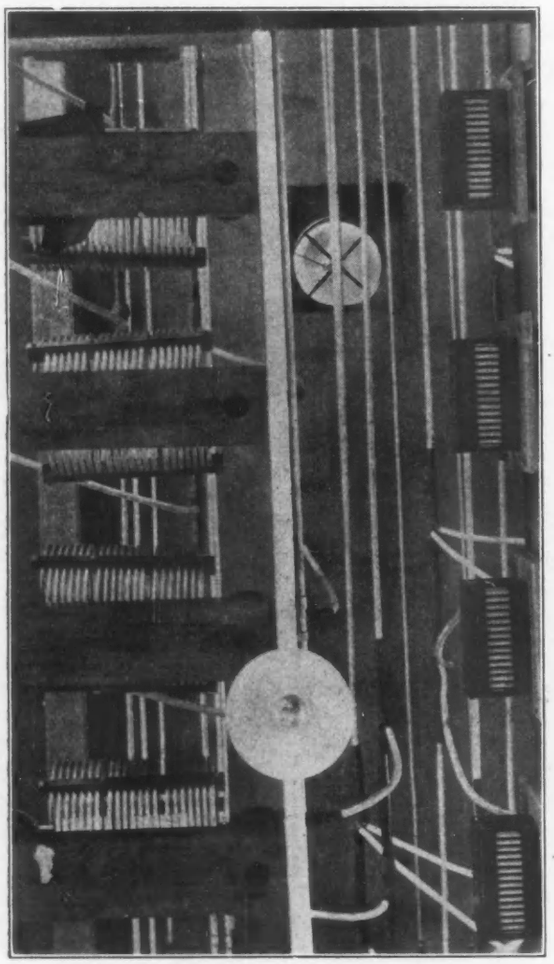


FIG. 10—VIEW FROM BELOW IN WIRE TOWER

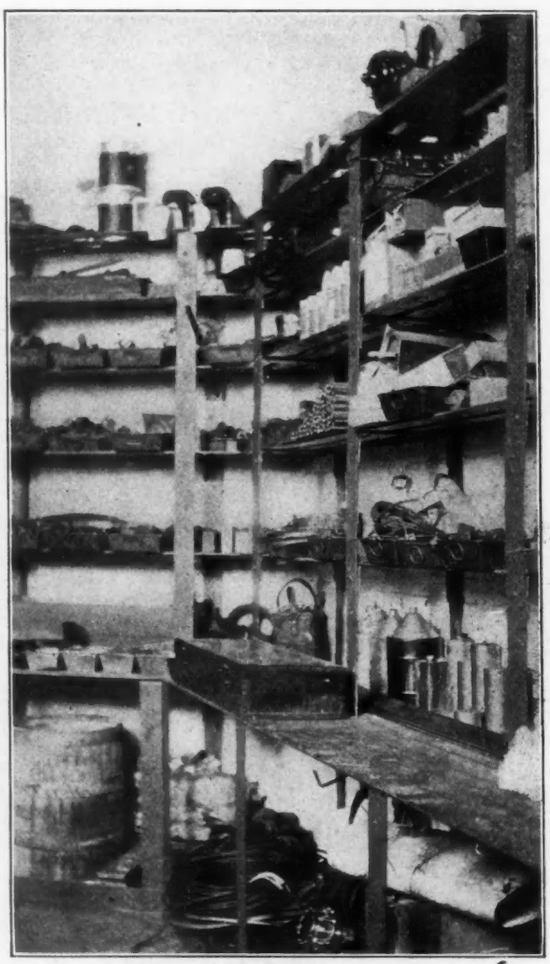


FIG. 12—STORAGE COMPARTMENTS

FIG. 13—LOCAL DISTRIBUTION CIRCUITS

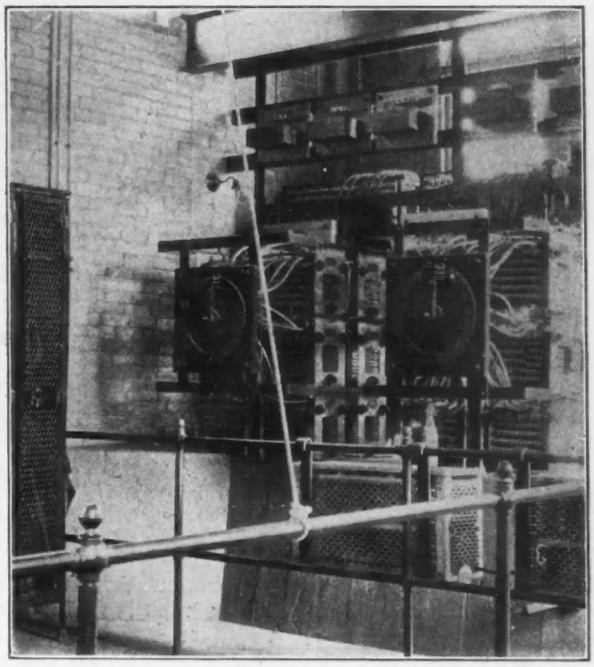


FIG. 15—RHEOSTATS IN WIRE TOWER

line terminates at each end in a short tap leading to the choke coil. Three 75-kva station service transformers are mounted in this tower, with two tub transformers for street lighting. The generator field rheostats are also placed here, on a concrete platform illustrated in the accompanying photograph. The approach to the station is by a handsome concrete stairway running along the river bank, this being illuminated by five Mott iron standards carrying five 16-cp incandescent lamps each above the balustrade.

The 11,000-volt lines which supply energy to the mills, and incidentally to Dixville, cross the river near the dam, where a substation has been built to raise the pressure from 2300 volts as received from the station proper for the short transmission to the principal users. The substation contains three 2500-kw Allis-Chalmers water-cooled transformers, with lightning arresters for incoming and outgoing lines, two 0.8 hp motor-driven centrifugal circulating pumps and disconnecting switches for the entering and departing lines. The lightning arresters are of the Westinghouse low-equivalent type on the 2300-volt side and of the General Electric aluminum-cell type on the outgoing-line side of the substation. The main plant is connected with the substation by three three-phase circuits, each leg consisting of two 300,000-circ. mil cables in parallel.

The 11,000-volt wiring is arranged so that if desired the choke coils and lightning arresters can be cut out by disconnecting switches carried on the higher tension framework, and a disconnecting switch is provided for

FIG. 14—STAIRWAY-APPROACH LIGHTING

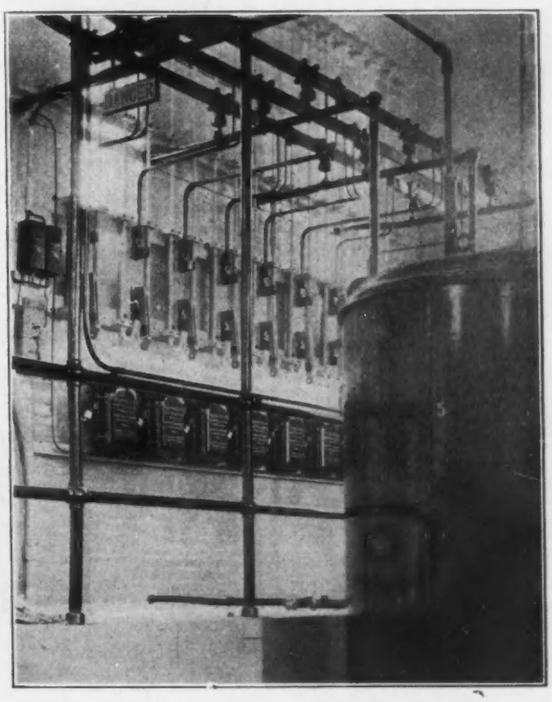


FIG. 16—TRANSFORMERS IN SUBSTATION ABOVE PLANT

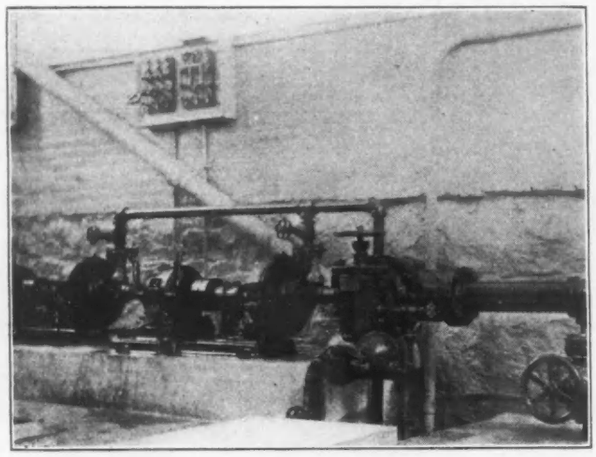


FIG. 17—CIRCULATING PUMPS FOR TRANSFORMER COOLING WATER

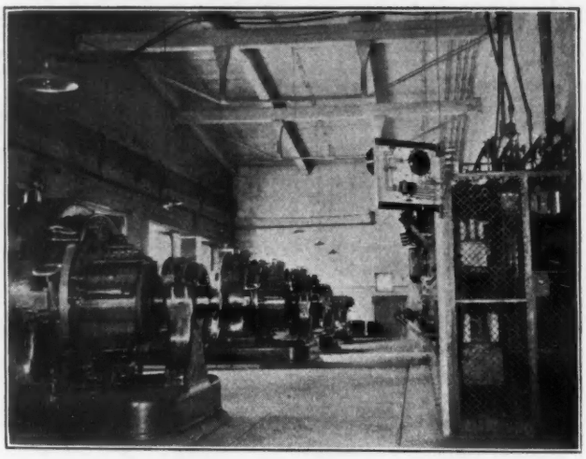


FIG. 19—MOTOR-GENERATOR SETS IN THE OXFORD PAPER MILL

each leg of the incoming 2300-volt lines. The outgoing lines are dead-ended on strain insulators carried on a steel frame on each side of the river, as shown, the span being 375 ft. The line is carried on 30-ft. to 60-ft. cedar poles set in a right-of-way about 125 ft. apart. The Dixville line is tapped off one circuit through Delta-Star pole switches, and Burke horn-gap switches are employed in the line just outside the substation of the Oxford Mills. The Dixville line is equipped with "wish-bone" cross-arms carrying insulators spaced on a 30-in. equilateral-triangle, cedar poles from 30 ft. to 35 ft. long being used. The 11,000-volt lines are all of No. 00 copper and are designed for ultimate operation at 22,000 volts.

Industrial Applications

The various mills are supplied with energy at 2300 volts from two substations, one containing three 300-kw transformers and the other three 2500-kva units. The former supplies the Continental Bag, Maine Coated Paper and Fort Hill companies, the last-named having a twenty-four-hour demand in the manufacture of chlorate of potash. In the Maine Coated Paper plant local distribution is at 550 volts from a private substation, with a 250-volt direct-current service for variable-speed motors derived from a 200-kw synchronous motor-generator set. The contract provides a bonus to the user dependent upon the power-factor of the installation, which ranges between 90 and 95 per cent. Besides two lighting transformers of 15-kw rating each, the plant is operated by three 15-hp induction motors driving six coating machines and carriers, three 75-hp variable-speed direct-current motors driving calenders, and various smaller motors driving cutting machines, a box department, screen, air-pump, elevators and small tools. The calender drive is new in the use of a hand control associated with the variable-speed feature which enables the speed of the paper at joints and other places to be closely regulated.

The Oxford Mills consume about 80 per cent of the output of the Rumford Falls Power Company, having a

FIG. 18—INDUSTRIAL SUBSTATION

FIG. 20—SUBSTATION ABOVE POWER PLANT

large twenty-four-hour demand. The local substation for the plant supplies eighteen beaters driven by motors rated at from 100 hp to 450 hp, with rope and belt drive, with three refining engines driven by independent motors rated from 100 hp to 150 hp, an electric bleach plant supplied with 220-volt direct current from five 325-kw motor-generator sets, and other paper machinery. The motor-generators were built by the Western Electric Company and the motors in the plant include Allis-Chalmers, Westinghouse and General Electric equipment. An interesting combination drive is that of a constant-speed shaft run by a steam engine and belted to a 180-kw generator wired to a 240-hp variable-speed motor directly connected to another shaft requiring a speed range of from 60 to 360 r.p.m. The mercury-cell electric-bleach process is employed. The line feeding the mill substation is carried on Coombs steel towers. A 125-hp municipal pumping load is a feature of the local central-station service, and the output of the hydroelectric plant averages about 40,000,000 kw-hr. per year, the station load-factor being approximately 90 per cent.

Mr. Charles A. Mixer is the chief mechanical and hydraulic engineer of the Rumford Falls Power Company.

A NEW ILLUMINATION PHOTOMETER

Portable Equipment for Determining Natural or Artificial Illumination Values Easily and Accurately

BY C. S. REDDING

A PORTABLE photometric equipment complete in all details essential for making the desirable determinations of illumination values in lighting installations, either natural or artificial, is shown in the accompanying illustration. By means of this equipment measurements of illumination or of surface brightness within the range of the eye can be made conveniently, easily and with a high degree of photometric accuracy. The usual color difficulties have been largely overcome and intensities up to many thousands of foot-candles have been brought within the range of convenient measurement.

A complete illuminometer weighing, including carrying case, from 14 lb. to 18 lb., depending upon the kind and size of battery used, surely answers the first requirement of portability.

The equipment shown in Fig. 1 consists of three main parts and various accessories.

The illuminometer proper (Fig. 2), weighing only 20 ounces, may be described as a vest-pocket edition of a modified Weber photometer. A Lummer-Brodhun cube with circular concentric fields is mounted in the head. The tungsten working standard lamp is fixed in a diaphragmed carriage which is moved up and down in the aluminum-tube body. The square brass rod projecting from the lower end is rigidly fastened to the lamp carriage and is operated with a substantial rack and pinion by either the right-hand or left-hand knurled handles at the end of the tube. The scale engraved upon the square rod is convenient for observation and is graduated to read directly from 1 ft.-candle to 25 ft.-candles. This scale follows the inverse square law and is theoretically correct and not experimentally determined for each instrument. The range may be considerably extended above 25 ft.-candles or below 1 ft.-candle, over a range of 100,000 to 1 if desired, by means of neutral absorbing screens of various densities, the actual ratio being practically limited only by the necessities of the operator. Special color screens have also been developed for use where great color differences exist, such as measurements with daylight, or where incandescent gas-mantle lamps, gas-filled tungsten lamps, flame-arc lamps, Moore tubes or mercury-vapor lamps are installed.

The controller, which is an addition to the usual portable photometer but a part of this equipment, is shown in the center of Fig. 1. This unit contains the battery, a Weston mil-ammeter with knife-edge pointer, two close-regulating rheostats and a reversing switch

FIG. 1—PORTABLE PHOTOMETER

as well as substantial connections for the various plug receptacles.

The third main part is the reference standard, shown diagrammatically in Fig. 3. This device provides a direct and simple means for each operator to standardize the working standard lamp within the illuminometer at any time or place. This convenience of standardization does away with all uncertainty as to the every-day condition of the working standard lamp, the dark room and auxiliary photometric apparatus, and, of still greater importance, it eliminates the personal factor which depends upon each operator's idea of a photometric balance. An operator is not given a current value for the working standard lamp, the light output of which will change throughout a comparatively short life, but is furnished with a certified cur-

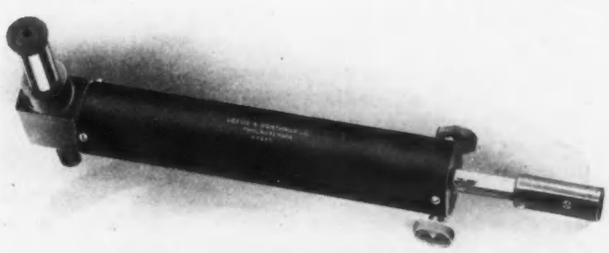


FIG. 2—20-OUNCE ILLUMINOMETER

rent value for this reference standard which will be used for only a few hours a year. The reference standard delivers a definite intensity of illumination in foot-candles on the test plate used with the equipment. The operator's personal peculiarities in relation to a photometric balance are considered thus in establishing the current value for the working standard lamp. Standardizing against a known illumination in-

tensity steps over the well-known personal differences of various photometric observers.

The illuminometer may be used in the usual manner, attached horizontally to a tripod with a rotating horn covered by a translucent test plate, the body of the operator being below the test plane, or measurements may be made as shown in Fig. 4, the operator standing in an easy, natural position and observing the brightness of the test plate, attached to a light-weight tripod.

Particular attention has been given to brightness measurements, a field of considerable importance which is receiving increased attention. By a simple change in calibration of the working standard lamp, considering the "apparent foot-candles[1] emitted" from the test plate with the reference standard, brightness measurements of all surfaces where the color differences are not prohibitive may be conveniently made by merely looking through the instrument toward the surface. This method renders the regular foot-candles scale direct reading without the use of factors for multiplying or dividing the scale values excepting where results are desired in terms of candle-power per square inch, per square foot, per square centimeter or per square meter. That part of the prism taking in the outside field is very small—about 3/32-in. diameter—and the angle subtended is also small. The distance between the observer and the surface is not a factor, however, so long as the surface is of uniform brightness over an area having a diameter of approximately one-tenth the distance. A surface 10 ft. in diameter will fill the

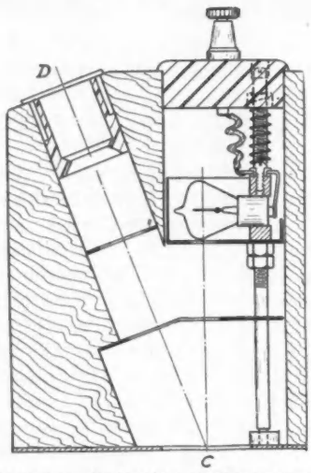


FIG. 3—DIAGRAM SHOWING REFERENCE STANDARD

photometric field when observed from any distance up to 100 ft.

A white glass with a special light diffusing finish is used for the test plates. This material and its surfacing were the result of an extended investigation. In the use of all ordinary test plates errors are invariably introduced as the angles of incidence of the light on the test plate or from the test plate to the illuminometer become greater with respect to the line perpendicular with the plate. The character of the test plate should be such that its coefficient of reflection is as nearly as possible independent of the angle of incidence of the light falling upon it or the position from which it is observed. With a given illumination a perfect plate would be of equal brightness when viewed from all directions. Such a surface has not been secured. An important advance, however, has been made beyond previous practice.

As is well known, the reflecting characteristics of surfaces vary with different materials and also with different surface conditions of the same material. Fig. 5 shows curves of four different materials from among a large number tested. Curve A represents the results obtained from a surface of smooth fresh-set plaster of paris. At an angle of incidence of 20 deg. there is an error of over 2 per cent. Curve B represents the results from block magnesium carbonate. This material gives good results up to an angle of 20 deg. but

FIG. 4—THE INSTRUMENT IN USE

poor beyond that point. Moreover, it is not a practical material to use for test plates. Curve D, which was reproduced directly from a paper by Edwards and Harrison[2], relates to the usual test plate heretofore in use. Curve C, representing the material adopted for the test plate in the illuminometer described herein, shows practically no error up to an angle of 25 deg., and from that point the error is much less than with the other materials indicated.

The plate selected may, if care is used, be washed with soap and water without danger of changing the character of the surface. It is preferable, however, to clean the test plate with a dilute acid solution in

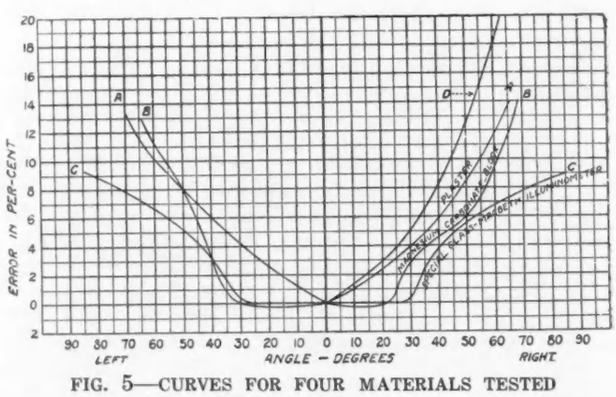


FIG. 5—CURVES FOR FOUR MATERIALS TESTED

order to remove any traces of grease from the surface.

The above-described photometric equipment, known as the Macbeth illuminometer, is the result of nearly four years of development work by Mr. Norman Macbeth, illuminating engineer, New York, and by members of the staff of the development laboratory of the Leeds & Northrup Company, Philadelphia, Pa.

[1]ELECTRICAL WORLD, Dec. 12, 1914, pages 1131 and 1157.

[2]*Transactions I. E. S.*, Vol. 8, page 642.

High-Voltage Transmission at High Altitude—II

Conclusion of the Description of the Chile Exploration Company's 110,000-Volt Installation in the Andes—Details of Line and Tower Construction

BY PERCY H. THOMAS, CONSULTING ENGINEER

AS a guide to the operating force in making effective use of the line, a chart of curves was plotted for the operator in the generating station to show the voltage, current, power-factor, kilovolt-amperes and kilowatts at the far end of the line, as well as the line efficiency for any given combination of current, voltage and power-factor. A similar curve chart was made for use in the substation.

The curve sheet designed for use in the generating station is reproduced in Fig. 10, and that for use in the

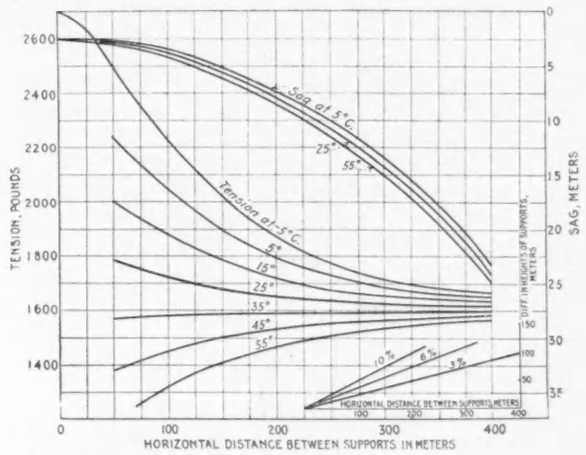


FIG. 8—CURVES SHOWING RELATION OF SAGS TO SPAN AND TEMPERATURE

substation in Fig. 11. From these curves it will be seen that the line is unusual in two or three features. First, its efficiency is very high for the load of 25,000 kw or thereabouts which it will be called upon to deliver. In the second place, the line almost perfectly balances, since the "leading power" effect of its electrostatic capacity nearly equals the "lagging power" effect of the line inductance at full load. Under non-inductive full load the line will operate at approximately unity power-factor throughout. The three synchronous motor-generators have sufficient capacity to raise the total power-factor to 95 per cent lagging. As a result of this condition the line drop is only a little in excess of that due to its ohmic resistance alone, which adjustment is the most efficient possible.

Stringing and Sagging of Cables

The field curves for stringing the conductor cable and showing the effect of temperature on sag for various spans are reproduced in Fig. 8. These curves have been calculated on the assumption that the cable is to be so drawn that in any span the stress would become 2700 lb. in case the conditions should change to the maximum wind at — 5 deg. C. already selected as the worst condition. These relations are plotted in a new form, which is more convenient, since the stress in the cable is the main feature of interest in fixing the sag. The determining of sag by temperature alone is uncertain since small errors in the temperature make large differences in the sag. It will be noticed that in this particular line, for temperatures between 30 deg. C. and 40 deg. C., the tension to which the cable should be stressed is nearly the same regardless of the length of span. It should be noted also that for very short spans the stress in the cable is the same regardless of whether the wind pressure exists or not. This is an interesting theoretical point and seems to involve an inconsistency. The correctness of the chart becomes clear, however, when it is remembered that the infinitesimal stretching that will be caused by the addition of wind pressure in a perfectly tight span to relieve the extra strain will not materially change the stress on the conductor, which has already been stretched to 70 per cent of its elastic limit. On the other hand, in very long spans the stress on the wire is practically directly proportional to the resultant loading and is almost entirely independent of temperature, because the sag is so great in the long spans as not to be largely affected by small changes in length.

Sag and Stress Calculations

All sag and stress calculations for the cables were made by the graphical method described by the writer at the annual convention of the A. I. E. E., Chicago, 1911. As compared with other methods this method represents a great saving of labor. The results were frequently checked by other methods.

Special approximate curves were derived for determining clearances between the line wires and the ground where adjacent towers were not on the same level. These curves are shown in Fig. 9, where each curve is drawn to represent the curve taken by a conductor in some assumed span when given such a sag at + 55 deg. C. as will cause a stress of 2700 lb. when the conditions change to — 5 deg. C. with the maximum wind. These curves were plotted on tracing cloth to the same scale as the profile of the line. To determine the clearance on any span the transparent curve sheet was laid over the profile with the point *A* on the curves directly over the position of attachment of the insulator on the high tower and with the axes of *X* exactly parallel on the curve sheet and on the profile. The profile of the

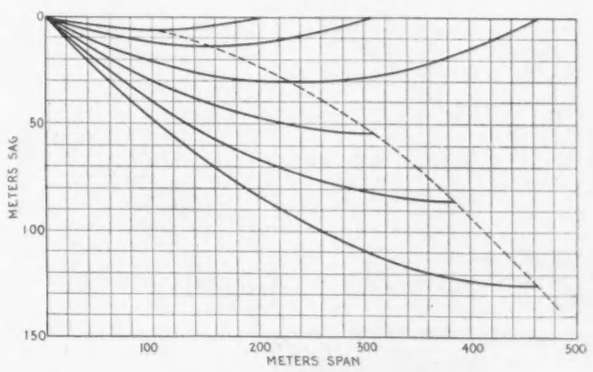


FIG. 9—CLEARANCE CURVE SHEET

ground between towers was then seen through the transparent cloth on which the curve was plotted, and one could readily see along what curve the conductor must lie to give the necessary clearance and determine at what points the second tower can be placed to hold the conductor at the proper height. Where the high tower is on the left instead of the right, as shown, the tracing was turned over, although, of course, the same curves might have been plotted reversed on another sheet. In-

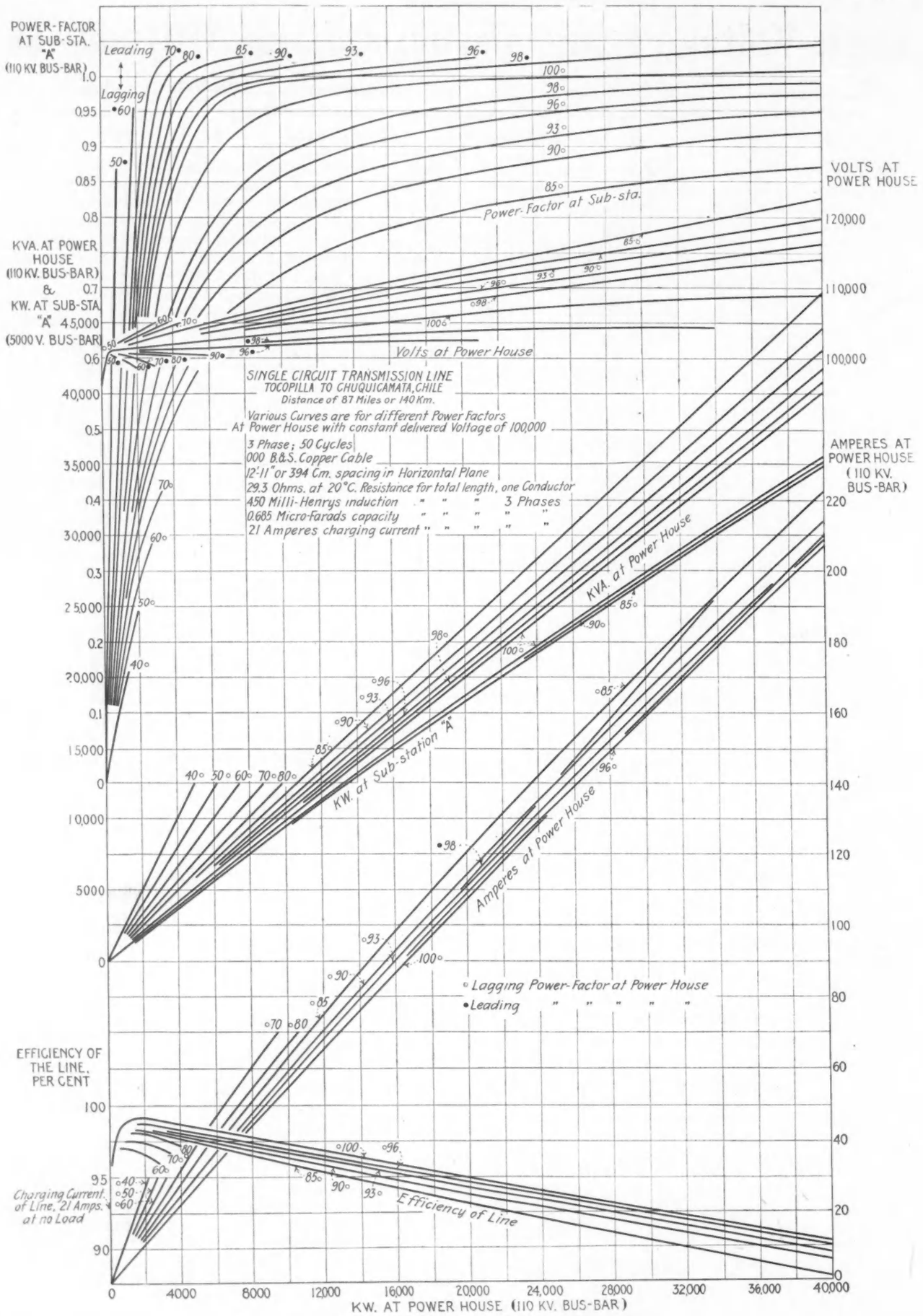

POWER-FACTOR AT SUB-STA. "A" (110 KV. BUS-BAR)
Leading
Lagging
KVA. AT POWER HOUSE (110 KV. BUS-BAR) & KW. AT SUB-STA. "A" (5000 V. BUS-BAR)
VOLTS AT POWER HOUSE
AMPERES AT POWER HOUSE (110 KV. BUS-BAR)
Power-Factor at Sub-sta.
Volts at Power House
KVA. at Power House
KW. at Sub-station "A"
Amperes at Power House
Efficiency of Line
SINGLE CIRCUIT TRANSMISSION LINE
TOCOPILLA TO CHUQUICAMATA, CHILE
Distance of 87 Miles or 140 Km.
Various Curves are for different Power Factors
At Power House with constant delivered Voltage of 100,000
3 Phase; 50 Cycles
000 B.&S. Copper Cable
12'-11" or 394 Cm. spacing in Horizontal Plane
29.3 Ohms. at 20°C. Resistance for total length, one Conductor
450 Milli-Henrys induction " " " 3 Phases
0.685 Micro-Farads capacity " " " " "
21 Amperes charging current " " " " "
° Lagging Power-Factor at Power House
• Leading " " " " "
EFFICIENCY OF THE LINE, PER CENT
Charging Current of Line, 21 Amps. at no Load
KW. AT POWER HOUSE (110 KV. BUS-BAR)

FIG. 10—REGULATION CURVES FOR POWER HOUSE

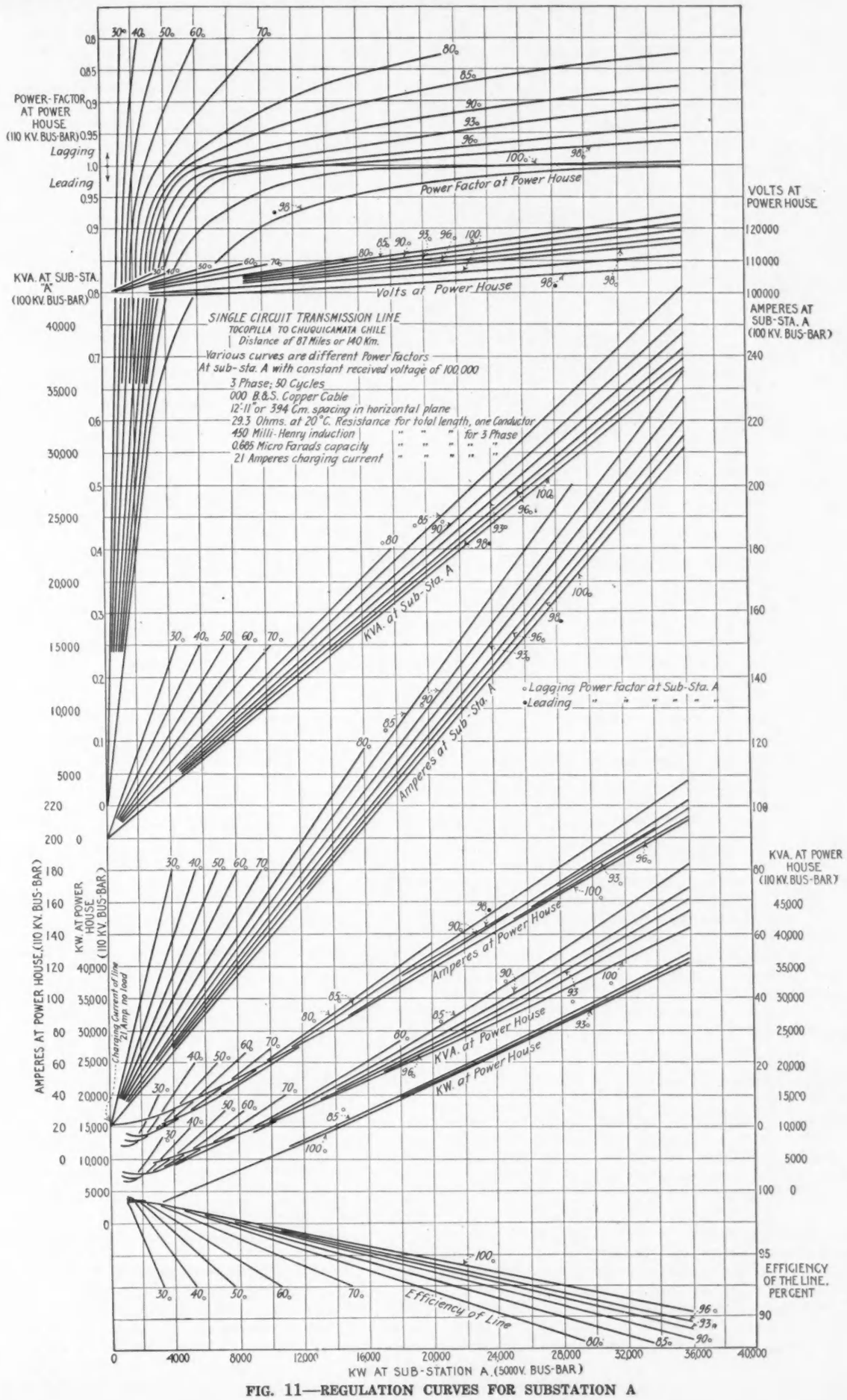

POWER-FACTOR AT POWER HOUSE (110 KV. BUS-BAR)
Lagging
Leading
Power Factor at Power House
KVA. AT SUB-STA. "A" (100 KV. BUS-BAR)
Volts at Power House
VOLTS AT POWER HOUSE
AMPERES AT SUB-STA. A (100 KV. BUS-BAR)
SINGLE CIRCUIT TRANSMISSION LINE
TOCOPILLA TO CHUQUICAMATA CHILE
Distance of 87 Miles or 140 Km.
Various curves are different Power Factors
At sub-sta. A with constant received voltage of 100,000
3 Phase; 50 Cycles
000 B.&S. Copper Cable
12'-11" or 394 Cm. spacing in horizontal plane
29.3 Ohms. at 20°C. Resistance for total length, one Conductor
450 Milli-Henry induction " " " for 3 Phase
0.665 Micro Farads capacity " " " " "
21 Amperes charging current " " " " "
KVA. at Sub-Sta. A
Amperes at Sub-Sta. A
Lagging Power Factor at Sub-Sta. A
Leading " " " " " "
AMPERES AT POWER HOUSE (110 KV. BUS-BAR)
KW. AT POWER HOUSE (110 KV. BUS-BAR)
KVA. AT POWER HOUSE (110 KV. BUS-BAR)
Charging Current of line 21 Amp. no load
Amperes at Power House
KVA. at Power House
KW. at Power House
Efficiency of Line
EFFICIENCY OF THE LINE, PERCENT
KW AT SUB-STATION A. (5000 V. BUS-BAR)

FIG. 11—REGULATION CURVES FOR SUBSTATION A

terpolation between curves may be resorted to. This arrangement of span curves on transparent cloth, which was devised by Mr. Walter Dickson, was found very convenient. The results obtained with it are, of course, only approximately correct, since the assumption has to be made that the change in the sag due to the change in temperature from + 55 deg. C. to — 5 deg. C.

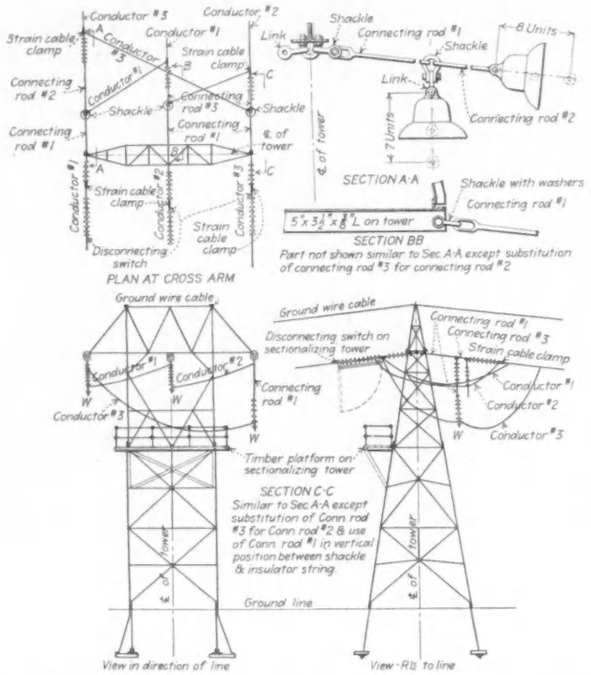

Conductor #3
Conductor #2
Conductor #1
Strain cable clamp
Connecting rod #2
Connecting rod #1
Shackle
Link
Connecting rod #3
℄ of tower
8 Units
7 Units
SECTION A-A
Shackle with washers
5"x3½"x⅝"L on tower
SECTION BB
Part not shown similar to Sec. A-A except substitution of connecting rod #3 for connecting rod #2
Disconnecting switch
PLAN AT CROSS ARM
Ground wire cable
Disconnecting switch on sectionalizing tower
Strain cable clamp
Timber platform on sectionalizing tower
SECTION C-C
Similar to Sec. A-A except substitution of Conn. rod #3 for Conn. rod #2 & use of Conn. rod #1 in vertical position between shackle & insulator string
Ground line
View in direction of line
View Rt. to line

FIG. 12—OUTLINE OF TRANSPOSITION AND SECTIONALIZING TOWER

occurs in the full-length span, which, of course, is not the case. It is believed, however, that the clearances determined by this method are always on the side of safety.

Transpositions

The method of making transpositions in the line is shown in Fig. 12. The transpositions are made on one side of and close to a dead-end tower. At all points two strings of insulators lie between any two line wires, and a minimum clearance of 6 ft. is maintained between the lines. The transposition was made close to the tower in order to avoid the crossing of one wire over another in the middle of a long span. The arrangement is such that one side of the tower is free for the installation of sectionalizing switches and an operating platform whenever necessity may arise.

Tower Tests

The tower designs were arrived at as follows: Tenders were called for to meet a certain specification in which a general tower outline and no structural details were given, but in which a specified loading was set down. When the best tender with detail design had been selected a single tower was built and tested, and a slightly modified design was adopted as a result of this test.

According to the original specifications, any three of the five cables on one tower could be assumed broken with a resultant pull of 1700 lb. on each of the insulator supports where the conductor was assumed broken and 2500 lb. on each ground-wire support where the ground wire was assumed broken. This condition was to be withstood simultaneously with a wind pressure of 30 lb. per sq. ft. on flat surfaces across the line, a transverse pull of 300 lb. on each insulator support and 350 lb. on each ground-wire support representing the wind pressure in the cables, together with a pressure of 1000 lb. downward on each insulator support to represent the dead weight of the cables and the downward component of the pressure on vertical angles. The test tower was mounted on rigid foundations, since it was hardly feasible to establish proper competitive conditions on towers placed on field foundations; moreover, the soil conditions along the actual route of the line were not at that time known.

When loaded in accordance with the specification the tower showed no distress. The load was made greater by increasing first the transverse and then the longitudinal stresses until the tower finally failed by buckling of one main leg, under which conditions the transverse load was double the specification load and the longitudinal load was 30 per cent in excess of the specification load.

Additional tests were made by stressing each insulator support separately to 3000 lb. and each ground wire connection to 5000 lb. without signs of distress.

Tower Foundations

A great deal of care was taken with the tower foundations. Obviously, no tower, however strong or well designed, will give good results unless each and every foundation supporting point is properly placed and maintained. The displacement of one of the four points of support by only an inch will produce very considerable internal stresses in the towers. The accuracy of the setting of the four points of support depends almost wholly on the care exercised in the field, but where steel foundation stub angles are used to support the tower weakness may be inadvertently introduced in

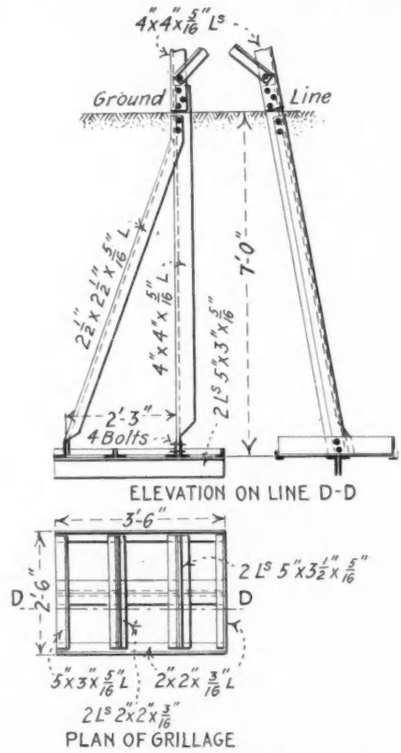


FIG. 13—DESIGN OF ANGLE TOWER

the tower structure even when the four foundation stubs are placed in exactly the correct relative positions. Whatever horizontal pull, either longitudinal or transverse, exists on the tower must be resisted by a horizontal force at the top of the foundation stub angles, and the overturning moment of the force on the tower must be balanced by an upward thrust on the near stubs

and a downward pull on the far stubs. Unless the resultant of the upward (or the downward) and the horizontal thrust lies along the axis of the stub angle, a bending movement will be produced on the stub. There is nothing to resist the bending of the tops of the stub other than its natural strength except the resistance of the earth, which resistance is small near the surface of

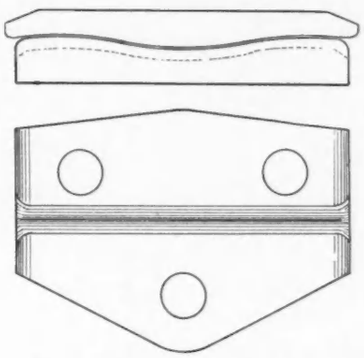


FIG. 14—CLAMP FOR HOLDING CABLE

the ground. Consequently a foot or more of the top of the stub may be largely unsupported and hence may be required to resist bending like a cantilever beam. To reduce the stress in the stub produced by such forces use was made of two sets of shear plates located about 8 in. below the surface of the ground to support the stubs, both across the line and with the line. The shear plates resisting the transverse stresses were mounted above the other shear plates because the transverse bending stresses were exerted far higher than the longitudinal bending stresses in the towers.

Bending Stresses in the Stubs

Since a tower is by no means a perfectly rigid structure and the horizontal thrusts are not divided between all four stub angles equally but are largely concentrated on two of the stubs, the bending stresses in the stubs are high. The horizontal thrust is transmitted to the bottom of the tower legs by the tower diagonals, and these are much more rigid in tension than in compression, so that the stubs to which the tension diagonals are attached are subjected to the greatest stress of all.

In the Chile Exploration Company's towers (see Figs. 1 and 2) longitudinal stresses produce very little bending moment in the stubs, while transverse stresses on the tower cause very material bending stresses in the stubs. A resultant longitudinal stress applied at the peak of the tower in Fig. 2 would develop stresses on the tower legs directly along these members without exerting a bending component. Now, the actual resultant longitudinal stresses in service are applied closely enough at the peak so that no material bending is produced. However, a transverse force at the apex of the tower in Fig. 1 will be seen to cause a force on the stubs (which are vertical in this plane) having a very considerable bending component on the top of the stub. This bending moment was counteracted, as already explained, by mounting an 8-in. by 12-in. shear plate a few inches below the surface of the ground.

Special bases or extensions were used on towers higher than standard erected on tangents, and to the legs of the extensions was given a slant in both directions at such an angle as practically to eliminate the bending moment in the stubs across the line as well as with the line.

In angle towers, in which the stress across the line is considerably greater than the transverse stress in the standard tower, use was made of a braced stub, as shown in Fig. 3, or the foundations were made of concrete, on which, of course, the bending moment would have no effect.

Overhead Ground Wire

The overhead ground wire has two functions, to guard against lightning and to act as a mechanical support in case of the failure of a main member in a tower. From an electrical point of view there is nothing particularly novel in the Chile Exploration Company's ground wires except that an unusually wide separation between these wires and the conductors is provided at the tower and a still greater separation is secured in the middle of the span in order to maintain a large discharge distance for lightning between the ground wires and the conductors. Of course, a much wider distance is required in the center of the span than at the tower, since the tower acts as a ground connection to discharge any electricity accumulating on the ground wire.

The duty of the ground wire and the ground-wire clamp, as a mechanical support, in a tower line is an exacting one. While laying out the specification and the tests of the Chile Exploration Company's towers it was assumed that the ground wire offers no support to a tower, although in fact when a tower is stressed longitudinally beyond its elastic limit and some part of it or of its foundation fails partially, the top of the tower will yield toward the stress and very quickly tighten up the ground wires and no further yielding will be possible without breaking the ground wires, which have sufficient strength to resist very heavy stresses. A complete failure of the tower will thus often be prevented by the ground wires, and the tower may afterward be replaced at leisure. In order to serve as a reserve in such a case, the ground-wire cable must be clamped to the tower so securely as not to slip under stress, at least up to the elastic limit of the cable, and preferably not to slip even when the cable is actually pulled apart. Moreover, the clamping should be accomplished without injury to the cable, and the clamp must hold the cable without causing it to be injured by swinging in the wind.

For use on the Chile Exploration Company's line there

FIG. 15—TWO POSITIONS OF CABLE WHEN HELD BY NEW CLAMP

was developed a new clamp which meets this condition and will hold the cable without injuring the strands. This clamp is shown in Fig. 14. The cable, which is of seven strands, lies in a 60 deg. groove in the lower of two castings, the upper casting being bolted down onto the cable.

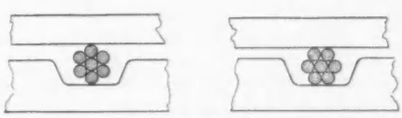


FIG. 16—TWO POSITIONS OF CABLE WHEN HELD BY ORDINARY CLAMP

The adjacent surfaces of the two castings, with the center line of the grooves, are curved similarly and in such a way that a depression or valley runs across the middle of the clamp at right angles to the cable, as indicated by the dotted line in the upper part of the cut. When a tension exceeding the elastic limit is applied on

the cable to the right of the clamp, for example, the cable will stretch and thus reduce its diameter, but will merely draw deeper into the V groove at the right of the valley. It will still be held by the V groove at this point with such force that the stress remaining to be taken up by the portion of the clamp at the left of the valley will be less than the elastic limit, and hence this part of the cable will not scratch and slip.

The test of the clamps showed that, while a marked point on the cable on the stressed side of the clamp pulled some 0.5 in. before the cable broke (outside the clamp), the cable on the slack side of the clamp had not moved. Thus the 0.5-in. motion of the cable under the stresses was the stretch of that portion of the cable within the clamp lying to the right of the valley.

An advantageous characteristic of this clamp is the relatively long distance that separates the cable groove and the third bolt, which introduces a certain amount of spring in the casting and takes care of temperature changes. The castings are of galvanized steel. The bolts (⅝ in. in diameter) must be drawn very tight to hold a ⅜-in. galvanized cable stressed up to 9000 lb., its ultimate limit. On account of the shape of the clamp the cable is absolutely uninjured by the pressure except for the scratching of the layer of galvanizing.

The advantage of the 60-deg. V groove can be seen from Fig. 15, showing two positions of the cable in the clamp, while Fig. 16 shows the grip on the cable in the ordinary shallow groove clamp. In Fig. 15 the middle strand of the cable is firmly gripped, while in Fig. 16 the cable may be crushed through the movement of the middle strand or the spreading of the top and bottom pairs of strands. The various features of the line that have been described include most of those of general interest. In other respects the transmission line follows pretty closely the usual types of construction.

The entire development of the Chile Exploration Company's property is in charge of Mr. Pope Yeatman as consulting engineer, Mr. E. S. Berry and Mr. George P. Bartholemew being assistant consulting engineers. The metallurgical process is under the supervision of Mr. E. A. Cappelin Smith, who has developed it in detail. The general manager of the property is Mr. Fred Hellmann, who is stationed in Chile. The transmission line was designed by Mr. Percy H. Thomas, consulting electrical engineer. The erection of the transmission line is in charge of Mr. Norman Rowe.

Factors Hindering Production of High-Rated Internal-Combustion Engines

A prominent English engineer says that three fundamental factors are chiefly responsible for the difficulties which are encountered in designing internal-combustion engines of existing types and especially those having high ratings. These factors are: that the heat per unit of surface radiated by the flame to the cylinder walls increases with the size of the cylinder while the thickness of metal through which the heat has to reach the cooling medium also increases; that the weight per horse-power increases with the size of the cylinder, and that forces are called into play which are useless because they are either stationary and do no work or even produce negative work.

Among the causes of useless forces are: pressure on the cylinder covers which must transmit their stresses to the engine frame, negative work during the compression stroke which in single-acting engines produces reversed stresses in the crank shaft, and inertia forces resulting from lack of balance and imperfect cushioning.

CENTRAL-STATION RETURNS FOR OCTOBER

Companies in Atlantic States Show Gain of 1.6 Per Cent in Income and 2.2 Per Cent in Output

Statistics of central-station companies of the Atlantic States for October, 1914, according to the returns received by the ELECTRICAL WORLD, indicate a gain in that section over October, 1913, of approximately $135,000 in gross and over 8,500,000 kw-hr. output. The figures are based on the returns from companies which produce 83 per cent of the output in that section and are shown in Table I. A comparative estimate of the operations during the first three months of the war and the corresponding three months of the previous year, based on these returns, shows an average monthly increase in gross of roughly $460,000. In the months preceding the war the monthly gain in gross was roughly $600,000, or

TABLE I—RETURNS RECEIVED FROM CENTRAL STATIONS IN THE ATLANTIC STATES OVER AN EIGHT-MONTH PERIOD

	Income Derived from Sale of Energy			Energy Output in Kw-hr.		
	1914	1913	Per Cent Increase	1914	1913	Per Cent Increase
February (54 per cent of industry)	$7,288,792	$6,655,011	9.8	231,790,165	205,726,060	12.6
March (60 per cent of industry)	6,021,269	5,661,027	6.4	246,306,123	223,156,161	10.5
April (65 per cent of industry)	6,731,495	6,106,634	10.3	261,133,882	252,069,127	3.7
May (68 per cent of industry)	6,492,767	5,628,718	14.5	259,098,542	238,733,320	8.4
June (70 per cent of industry)	6,067,780	5,728,311	6.0	244,936,886	221,315,464	10.8
July (70 per cent of industry)	6,152,169	5,583,309	10.2	263,580,299	235,068,939	11.8
August (71 per cent of industry)	6,224,896	5,755,515	8.2	264,717,319	237,984,895	11.2
September (71 per cent of industry)	6,608,221	6,221,000	6.1	270,974,533	252,648,550	7.3
October (83 per cent of industry)	7,448,471	7,334,836	1.6	358,487,447	351,341,169	2.2

TABLE II—COMPARATIVE FIGURES FOR THREE LARGE COMPANIES REPRESENTING 35 PER CENT OF INDUSTRY OF MIDDLE ATLANTIC STATES

	Income Derived from Sale of Energy			Energy Output in Kw-hr.		
	1914	1913	Per Cent Increase	1914	1913	Per Cent Increase
February	$3,766,823	$3,497,948	7.8	112,892,266	108,302,262	4.2
March	3,492,149	3,386,190	3.1	118,897,901	114,136,574	4.2
April	3,437,634	3,194,160	7.6	112,894,803	105,328,705	7.2
May	3,113,526	2,476,781	28.2	108,171,896	104,267,718	3.8
June	2,952,454	2,844,643	3.7	103,013,271	97,628,941	5.7
July	2,933,019	2,648,625	10.8	106,607,151	97,459,526	9.5
August	2,906,057	2,692,408	8.0	107,656,963	100,753,254	6.8
September	3,083,956	3,003,008	2.8	109,732,933	108,123,057	1.5
October	3,403,867	3,395,769	0.2	124,601,349	122,536,832	1.7

one and one-third times the average gain during the early months of the war. In output the average gain for August, September and October was somewhat over 24,000,000 kw-hr., while during the previous three months it was approximately 35,000,000 kw-hr.

Figures for companies of large, medium and small earnings have been compiled. The increase in income for the large companies was 9.7 per cent in July, 7.5 per cent in August, 4.3 per cent in September and 1.1 per cent in October, while the gain in output for the corresponding months was, respectively, 9.7 per cent, 8.3 per cent, 2.8 per cent and 2 per cent. The companies of medium size showed a gain in income of 10.7 per cent in July, 7.6 per cent in August, 8 per cent in September and 6.3 per cent in October and in output of 16 per cent in July, 15.7 per cent in August, 13.2 per cent in September and 11.5 per cent in October. The small companies showed gains in income of 16.4 per cent, 18.7 per cent, 9.7 per cent and 7.7 per cent and in output of 9.3 per cent, 19 per cent, 13.4 per cent and 10.9 per cent for the respective months.

STATISTICS IN THE CENSUS RETURNS

Main Figures for Four of the Branches of the Electrical Industry

A forthcoming report on the electrical industries by the Bureau of the Census will contain many statistics which amplify the data contained in Bulletin No. 124 on the census of 1912. The report was prepared under the supervision of Mr. William M. Steuart, chief statistician for manufactures. Statistics published earlier by the Bureau of the Census were mentioned in articles published in the ELECTRICAL WORLD of Jan. 10 and March 14, 1914.

The 1912 census of electrical industries covers five distinct industries, which were designated as follows: (1) central electric light and power stations; (2) street and electric railways; (3) telephones; (4) telegraphs; (5) municipal electric fire-alarm and police-patrol signaling systems. The first of the large reports to be issued by the bureau will contain the statistics for the central electric light and power stations and street and electric railways. The other groups will be covered in a separate report. A table published herewith shows the main statistics for the first four of the industries named. Statistics of this character are not available for the municipal electric fire-alarm and police-patrol signaling systems because they are not operated commercially.

The capitalization stated for central electric light and power stations compares with $1,096,913,622 in 1907 and $504,740,352 in 1902. The percentage of increase in capitalization during the period of five years ended with 1912 is shown to have been greater than the rate of increase in either gross income, expenses or net income. The percentage rates of increase in gross and net income and expenses are very close together. The percentage rate of increase in expenses during the period of ten years ended with 1912 was less than the gain in gross or net income. During the period of five years ended with 1912, however, the expenses gained at a rate a little greater than the increase in gross and net income.

The statistics indicate a capitalization of $7.20 per $1 of gross income for central electric light and power stations, $8.13 for street and electric railways, $3.89 in the telephone industry and $3.49 for land and ocean telegraphs.

Isolated electric plants are mentioned in the report. The time and means available did not make a thorough canvass of all isolated plants practicable. However, reports were collected by special agents engaged in the field work from a few isolated plants and were supplemented by additional returns obtained by mail. The figures for 121 plants of this character show the following: Total primary horse-power, 102,187; kilowatt capacity of dynamos, 68,466; estimated number of lamps wired for service, all varieties, 152,958.

The returns of central electric stations include those of a number of electric-railway companies which have special departments for the sale of electrical energy and therefore made separate reports. There were, however, 169 electric railways which operate electrical plants and sell energy that were unable to make full separate reports corresponding to the regular reports. The total income in the light and power departments of these companies in 1912 was $31,515,582, an increase of $25,045,856 over 1902. In addition, a number of companies which were not able to furnish statistics of electric service, even of the brief character given by the 169 companies, reported an income from the sale of energy of $5,515,475.

The rate of increase in central electric station development has been much greater than that of gas plants. A comparison of the returns of central electric stations for 1902, 1907 and 1912 with the returns from the gas plants for 1899, 1904 and 1909 shows the rapid development of the former class of properties. The combined gross income of the two industries for the earliest years stated was divided between 54.8 per cent for the electrical industry and 45.2 per cent for the gas industry. For the latest years named the percentages were respectively 67.4 and 32.6. From 1899 to 1909 the gross income of the gas plants gained 120.3 per cent; from 1902 to 1912 central electric station gross income gained 252.5 per cent.

The tendency toward the corporate form of ownership for commercial central electric stations is indicated by the figures. The small extent of the properties controlled otherwise than by incorporated companies is shown by the relative figures of gross earnings in 1912, as follows: Incorporated, $274,389,808; firm, $1,575,096; individual, $2,931,706.

ELECTRICAL INDUSTRIES* IN 1912

	Central Electric Light and Power Stations	Street and Electric Railways	Telephones	Telegraphs (Land and Ocean)
Number of companies, stations or systems	5,221	1,260	†1,916	‡27
Employees, salaries and wages:				
Average number	79,335	282,461	183,361	37,295
Salaries and wages	$61,161,941	$200,890,939	$96,040,541	$24,964,994
Capitalization¶	$2,175,678,266	$4,708,568,141	$991,294,115	$226,386,810
Per cent of increase§	331.0	104.0	184.8	38.9
Per cent of increase**	98.3	24.7	30.8	2.8
Income	††$302,115,599	$579,208,430	$255,081,234	$64,762,843
Per cent of increase§	252.5	131.2	193.8	58.2
Per cent of increase**	72.0	35.7	44.4	25.5
Expenses—Total, including salaries and wages, interest, taxes and fixed charges	$234,419,478	$497,782,682	$203,754,909	$58,378,952
Per cent of increase§	244.3	145.7	212.6	88.6
Per cent of increase**	74.7	39.0	50.4	39.4
Net income	$67,696,121	$81,425,748	$51,326,325	$6,383,891
Per cent of increase§	260.8	69.8	137.0	‡‡−36.0
Per cent of increase**	63.3	18.5	24.5	‡‡−34.2

*Not including municipal electric fire-alarm and police-patrol signaling systems.
†Exclusive of systems reporting an annual income of less than $5,000.
‡Includes the Commercial Cable Company of Cuba.
¶Cost of construction and equipment.
§1912 over 1902.
**1912 over 1907.
††In addition, $36,300,030 was reported by street and electric railway companies as income from sale of electric energy for light and power, or from sale of energy to other public-service corporations.
‡‡A minus sign (−) denotes decrease.

DIGEST OF ELECTRICAL LITERATURE

Generators, Motors and Transformers

The Magnetic Field of the Three-Phase Induction Motor.—F. T. CHAPMAN.—The saturation of the teeth of stator and rotor introduces harmonics into the rotating flux wave of the induction motor. Some effects of the third harmonic are illustrated, and some causes are indicated which tend toward the suppression of this and the other harmonics in certain cases. Although the main flux wave of the induction motor may contain important harmonics, notably a third, only the fundamental contributes to the effective back emf of the motor. The third harmonic causes a considerable distortion of the currents in the stator windings of a delta-connected motor, which leads to an appreciable reduction of this harmonic. In a loaded squirrel-cage motor the slip causes currents in the rotor windings, which go far to suppress the third and other harmonics altogether. The reluctance of the teeth can be calculated as though it were constant at the value it would have with a mean air-gap density equal to $1.36\varphi/S$ where φ is the total number of lines of force per pole in the fundamental wave and S the polar area of the air-gap path.—London *Electrician,* Dec. 11, 1914.

Stresses in Rotor Bindings.—ARTHUR MORLEY.—A mathematical article in which the author develops formulas for the stress set up in the binding wires on the rotors of electric generators. The centrifugal forces induce in part an increase of tension in the binding and in part a diminution in the compression of the rotor, which compression initially balances the tension of the binding. The calculation of the stresses is illustrated by the simple case, of which there are occasionally practical examples, for easy removal of a thin, hollow bronze hub, containing uniformly distributed loose, free mases, the hub being bound with a layer of thin steel wire and rotated at high speed. A numerical example is added.—London *Engineering,* Dec. 18, 1914.

Limitations in the Construction of High-Tension Direct-Current Machines.—A. SCHERBIUS.—An illustrated English translation in abstract of his German paper on this subject abstracted some time ago in the Digest.—London *Electrician,* Dec. 18, 1914.

Generation, Transmission and Distribution

Protection of High-Tension Circuits Against Dangerously High Voltages.—KENELM EDGCUMBE.—A long illustrated article in which the author reaches the following conclusions: As a protection against static charges, all long overhead lines in exposed positions should be provided with "permanent leak" inductive resistances. On all overhead systems the plant should be protected by line-choking coils. As a protection against steep-fronted waves due to lightning, condensers can be used, but they are expensive and are of no use as a protection against any other form of disturbance, whether on overhead or underground systems. Consequently, if condensers are used at all they must in all cases be supplemented by some form of discharge gap capable of dealing with other forms of disturbance. Discharge gaps installed in conjunction with line-choking coils are quite capable of dealing with disturbances of both kinds, so that the extra cost of installing condensers is seldom justified. The discharge gap must not break the circuit too suddenly and should be sufficiently robust to allow of its being connected directly to the line without the interposition of a fuse. The horn discharger best fulfils these requirements. When acting, the discharger must not constitute a dead earth or short-circuit and must, therefore, have a limiting resistor in series. The limiting resistor should be robust, non-inflammable, unaffected by heat or frost, not liable to deterioration under long or recurring discharges, and should require no attention over long periods. The Brazil form of carbon-powder resistor best fulfils these requirements. The resistance of the

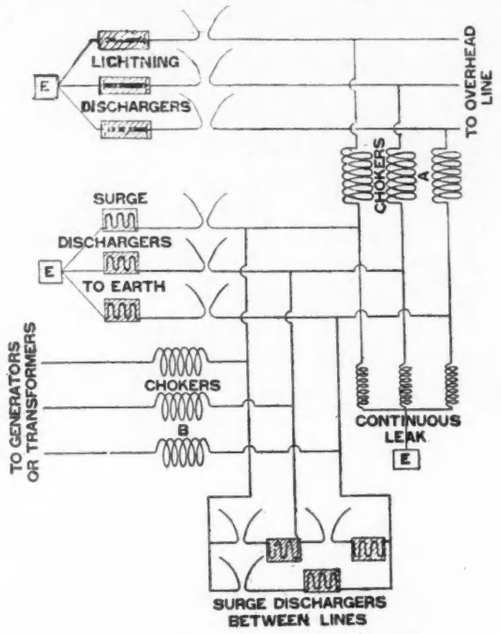


FIG. 1—WIRING CONNECTIONS FOR OVERHEAD SYSTEM

resistor must be high enough to prevent undue disturbances to the system and low enough to afford relief to the line. One ohm per volt for cable systems and 0.1 ohm per volt for overhead systems has been found to meet practical conditions in every way. For lines subject to atmospheric disturbances the path to earth should be as straight as possible, and even for cable systems it should be reasonably non-inductive. With properly proportioned protective gear internal surge discharge gaps may be set as low as 50 per cent, and atmospheric disturbance gaps from 100 per cent to 200 per cent, above the line pressure. On the insulated systems internal disturbances normally arise between lines, and the dis-

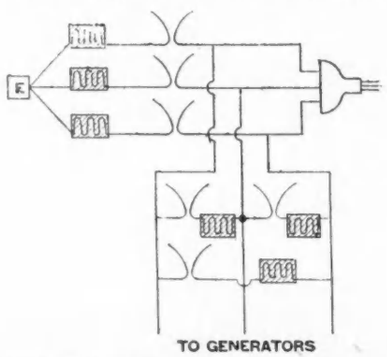


FIG. 2—WIRING CONNECTIONS FOR UNDERGROUND SYSTEM

chargers should be connected accordingly. At the same time it is best not to dispense with the earthed arrester on this account. Discharge indicators, with or without graphic attachments, should be installed at various points on the system. Fig. 1 shows the connections for a complete set of protective gear for an overhead system

or one partly overhead and partly underground. Fig. 2 gives the connections for an entirely underground system with insulated neutral. The three earthed arresters may in this case be omitted, although this is not recommended. If the neutral point of the generator is earthed, the dischargers between lines can be dispensed with.—London *Elec. Review*, Nov. 27, Dec. 4, 11, 18, 1914.

Traction

Economics of Electric Railway Distribution.—HORACE FIELD PARSHALL.—An abstract of a paper read before the (British) Institution of Civil Engineers. The author gives curves showing the relation of economical substation spacing to traffic density for different voltages. Other curves show the reduction in annual substation and track equipment cost with increased voltage. Another diagram shows the relation of most economical substation spacing to traffic tensity for single-phase systems at 5000 volts and 10,000 volts and for a three-phase system of 5000 volts.—London *Electrician*, Dec. 11, 1914.

Austrian Electric Railway.—E. E. SEEFEHLNER.—The conclusion of his illustrated article on the electric railway from Vienna to Pressburg. The author describes the telegraph, telephone and signal system and gives details of the equipment of the rolling stock.—*Elek. u. Masch.* (Vienna), Nov. 29, 1914.

Installations, Systems and Appliances

General Meeting of Association of Austrian and Hungarian Central Stations.—A report of the proceedings of the last general meeting held in June in Cracow. The association comprises 113 stations. Various legal matters were discussed as well as regulations, standardization rules, etc. A committee was appointed to provide measures to prevent the commercial position of the central stations from being hurt by the introduction of the half-watt lamp. The same committee is to consider also the tariff problem and means for using electrical energy for other purposes. J. Riedl presented a report on protective devices in high-tension installations against dangerous rises of voltage. Lunzer discussed electricity supply by a flat-rate tariff with the use of power-limiting devices. Other discussions related to oil switches, boilers, and the use of the Diesel engines in central stations. Papers were presented by Lederer on new developments in electric lighting and the use of vacuum tubes, filled with noble gases, at 220 volts, by Kesseldorfer on the theory and construction of the mercury motor meter, by von Winkler on the operation of hydraulic plants in ice and snow, and by Reiner on the damage done by stray currents from tramways to gas and water pipes.—*Elek. u. Masch.* (Vienna), Nov. 29, 1914.

Bradford Central Station Account.—An abstract of last year's financial account of the Bradford municipal electric central station. The generation expense per kw-hr. sold was 0.670 cent (against 0.690 cent a year before); distribution expense, 0.104 cent (against 0.110 cent); management expense, 0.142 cent (against 0.146 cent). The total cost including capital charges was 2.210 cents (against 2.382 cents); the total revenue per kw-hr. was 2.466 cents (against 2.548 cents); the balance was therefore 0.256 cent (against 0.166 cent). The output was just over 28,000,000 kw-hr. The year was a record year. Considerable progress was made toward popularizing the use of electric-cooking apparatus.—London *Electrician*, Dec. 18, 1914.

Electrophysics and Magnetism

Distribution of the Active Deposit of Radium in Electric Fields.—H. P. WALMSLEY.—The distribution of the active deposit of radium between the electrodes in an electric field is independent of the concentration of the emanation for small quantities but depends upon the dimensions of the apparatus. No negatively charged active deposit exists. Radium A is first positively charged and is then subjected to recombination like any other positive ions. Such neutralized active matter then diffuses to the metal surfaces irrespective of their potentials. From a comparison with the distribution in the case of actinium, it is shown that the anode activity consists of two parts—first, the active matter neutralized by recombination, and, second, a constant activity due to uncharged deposit which is independent of the field and only varies with the dimensions of the apparatus. The constant anode activity is not due to absorbed emanation or to a surface condensation of emanation on the electrode. It is suggested that radium A, which is responsible for this constant activity, is capable of forming a partition between the metal surfaces and the space in the apparatus, at ordinary temperatures.—*Philos. Mag.*, October, 1914.

Absorption Coefficients of X-Rays.—W. H. BRAGG AND S. E. PEIRCE.—A paper in which a general formula for the relation between wave-length and absorption coefficient is developed.—*Philos. Mag.*, October, 1914.

Resistance of Irregular Shape of Conductors.—J. F. H. DOUGLAS.—A mathematical article in which the author gives a new method for determining approximately the resistance of two-dimensional conductors of irregular contour.—*Phys. Rev.*, October, 1914.

Thermoelectricity and Magnetostriction of Heusler Alloys.—L. O. GRONDAHL.—An account of an experimental investigation of various Heusler alloys. The general results are as follows: The magnetostriction curves up to a field of 1600 gausses show no maximum and are always positive. Some of the curves showing the effect of the magnetic field on the thermoelectromotive force pass through a maximum negative value and reverse. The magnetostriction decreases as the temperature rises and disappears as the substance passes through the transformation range. The effect of the magnetic field on the thermoelectromotive force changes but does not disappear even at temperatures considerably above the transformation range. Hence the two effects seem to be entirely independent of one another. Although the effect of the magnetic field on the thermoelectromotive force in these alloys is very pronounced, Professor Ingersoll has found that they show no Kerr effect.—*Phys. Rev.*, October, 1914.

Units, Measurements and Instruments

Permeameter.—CHARLES W. BURROWS.—An account of a careful investigation of the accuracy and reliability of the Koepsel permeameter. This instrument is based on the action upon a coil carrying a known current of an electromagnet, made up of the iron to be tested with a known applied magnetomotive force. After a description of the construction of the instrument, various tests are described, and the results are summed up as follows: The Koepsel permeameter has several valuable characteristics. It gives direct readings of the magnetizing force and the magnetic induction, both for normal induction and for hysteresis data. It is easy of manipulation and does not require greater care than the usual deflection instruments. It repeats its readings as consistently as could be desired. The readings may be very useful in indicating relative values of different materials or the degree of non-uniformity of similar materials. The fact that the observed values of the magnetizing force may differ by as much as 100 per cent from the true values does not destroy the value of this instrument for purposes of comparison. From the experimental consideration of the different factors which

may affect the accuracy of the readings the following detailed conclusions were drawn: (1) Readings on the two sides of the zero of the instrument may differ considerably, but the mean of the two values thus obtained show satisfactory consistence on repetition. (2) Shearing curves for different grades of material show that the correction to be applied to the observed magnetizing force is not constant for a given induction but depends upon the nature of the test specimen. This correction is usually subtractive for points below the knee of the induction curve and additive for points above the knee. (3) An increase in the cross-section of the test specimen tends to increase the observed values of the magnetizing force for points below the knee of the induction curve and to decrease the observed values for points above the knee. (4) The length of the specimen projecting beyond the yokes produces no noticeable effect for points below the knee of the induction curve. For points above the knee the projecting ends increase the observed value of the magnetizing force. (5) If the bushings are not pushed all the way into their proper position, a higher apparent value of the magnetizing force is observed, due to the increased length of the portion of the bar under test. (6) Hysteresis loops obtained by the Koepsel permeameter always show a low observed residual induction and a high observed coercive force. (7) A theoretical and experimental study of the distribution of the magnetic fluxes through different parts of the magnetic circuit shows that shearing curves of the form observed are to be expected. If the apparatus is to be used for the determination of the absolute values of the magnetic quantities, it is necessary to apply a correction to the readings. Since the apparatus gives consistent results on repetition, the whole error may be charged to errors in the correction or shearing curve. As this shearing curve varies with the dimensions and quality of the specimen, it is essential that shearing curves be prepared for each size and quality of specimen to be tested. With extreme care and the use of proper shearing curves the apparatus is able to give quantitative results within 5 per cent of the true value of the magnetizing force for a given induction. Uncorrected hysteresis data for hard steels show values of the residual induction that are too small; the error may be as great as 10 per cent. Values obtained of the coercive force are systematically too large; the error may be as much as 40 per cent.—*Scientific Papers, Bureau of Standards*, No. 228.

Telegraphy, Telephony and Signals

Thermal Telephone.—M. DE LANGE.—An abstract of a Royal Society paper and a description of his new thermal telephone. The first thermophones were invented thirty-six years ago by T. Wiesendanger and two years later by Sir William Preece, the variations in the length of a platinum wire due to changes of temperatures being transmitted to a diaphragm. In the de Lange instrument there is no diaphragm. "The wire speaks without a diaphragm." While in open air the sound of the wire is very weak, yet when it is placed in a cover with one or several small openings the sound becomes clear and distinct. The cover acts as a resonator. The arrangement is shown in Fig. 3. The Wollaston wire (treated with acid according to Gwozdz's method) is seen at *A*, attached to two small brass half-circular blocks *B*, from which there project two small pins. These pins fit into a small socket, embedded in ebonite, to form the complete receiver. The metal cap, with a very small opening at the top, is slipped over the terminal blocks *B* and forms a resonator. An ebonite cap completes the whole. If a larger receiver is desired, such as can be placed against the ear in the ordinary way, half a dozen platinum wires are arranged in parallel. The platinum wire, which may be as small as 2 microns (0.002 mm), is, of course, actually much finer than the lines in the diagram, being invisible. The illustration shows the thermophone in full size for direct insertion in the ear. This receiver is intended to be worked simply in series with the transmitter, and therefore the usual transformers would be omitted. Mr. de Lange is confident that long lengths of line can be worked in this simple way. There should, therefore, be a cheapening of line material. In regard to the cost of the receiver itself it is obvious that it must be very much cheaper than the usual electromagnetic type. As to the theory of the instrument, it is simply said that the decrease and increase of heat on the platinum wire of the telephone takes place isochronously with the vibrations in the microphone. The air surrounding the

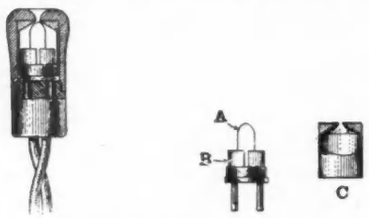


FIG. 3—THERMOPHONE FOR USE IN THE EAR

platinum wire is thereby immediately heated or cooled in accordance with the increase and decrease of heat in the wire, and, if that air is retained within a close compass of the cover, the expansions and reactions are noticed as sound.—London *Electrician*, Dec. 18, 1914.

Book Reviews

THE SCIENCE AND PRACTICE OF MANAGEMENT. By A. Hamilton Church. New York: The Engineering Magazine Company. 536 pages. Price, $2.

Persistent efforts are being made to reduce to system and law the management of large organizations. Most of these efforts spring from the very laudable impulse of trying to subject certain processes to rule and formula. The book before us furnishes an example of such effort. To reduce the problems of organization and operation to elementary axioms and doctrines would seem to most people to be a very wearisome, if not a futile, task. While trying to find general rules, the problems change, the personnel is altered, new conditions arise, and the laboriously built-up theory may become of little value. The book, none the less, is interesting.

KONSTRUKTION, BAU UND BETRIEB VON FUNKENINDUKTOREN. Vol. I, Funkeninduktoren. By Ernst Ruhmer. Berlin: *Der Mechaniker*. 232 pages, 328 illus. Price, 6.5 marks.

An elementary treatise on the spark coil giving prominence to the design, construction and operation of such coils. The book is excellently and abundantly illustrated. The mathematics are simple and prepared from the technical rather than the physical point of view. The twelve chapters of the book relate to the following subjects: Introduction, mathematical principles, physiological induction coils, small spark coils, large spark coils, direct-current and alternating-current interrupters, frequency measures, sources of energy, auxiliary apparatus, assembling apparatus, additional methods of operation, experiments with spark coils. The book will be of service to all who are interested in the construction and use of induction coils, especially large coils, as distinguished from spark coils.

POWER AND OPERATING SECTION

Improvements in Auxiliaries

COINCIDENT with the increase in output rating and the accompanying improvement in the efficiency of steam turbines there have been corresponding changes in the output and efficiency of the auxiliaries, the most important of which is the condenser. By reason of refinements as well as improvements in design of both the turbines and the condensers turbo-units rated at 30,000 kw are now being adopted, whereas 20,000 kw was considered the maximum possible rating several years ago. The steam consumption in the meanwhile has been reduced from 13 lb. to 11 lb. per kw-hr., a saving of more than 15 per cent. Credit for the reduction in steam consumption is usually given to the turbo-generator, but sight should not be lost of the fact that without adequate refinements in the design of the condensers and other auxiliaries required for maintaining those conditions under which the turbine operates with the best efficiency the reduction noted would have been impossible. It is of prime importance that improvements in condensers have kept pace with those in turbines and generators.

Uniform Boiler Specifications

IN all probability uniform specifications for steam-boiler construction will soon be a reality in the United States. The long-continued and much-discussed report of the boiler code committee of the American Society of Mechanical Engineers is approaching its end, and the construction code is rapidly assuming form. The society is to be congratulated on this work, in which its own committee and an advisory committee representing all organizations interested in boiler practice in any form have been long engaged. It would be too much to expect perfection of a code that represents compromises, yet there can be no doubt that such a code will suffice for legislative purposes. The particular feature of the movement in which we are most interested, however, is that national professional bodies are slowly realizing their obligations in guiding legislation for which they are eminently fitted and the aim of which is neither mercenary nor selfish but the protection of society considered as a whole.

What Is "Low Tension"?

IF an old-time operator—one who used to attach a rope to a 1000-volt switch and get behind a friendly station partition to open the breaker—were to visit certain modern hydroelectric plants and observe the offhand manner in which the operators speak of 13,200-volt apparatus as "low tension," he would no doubt question the sanity of the younger men. A few years ago any potential below 2300 volts—more specifically, 110 volts or 550 volts—was spoken of as low-tension, but with the coming of transmission circuits of 100,000 volts and over. and with 13,200-volt distribution lines being carried into transformer banks of industrial plants, as is now frequently done, the comparative expression "low tension" has taken on a pretty broad application. Owing to the increased number and effectiveness of protective devices. it is probably true that the operator of to-day is safer while handling lines carrying 13,200-volt energy than was the pioneer who attempted to work with potentials of 1000 volts. Nevertheless, for the sake of the utmost safety and to avoid acquiring that contempt which familiarity is likely to breed, we should encourage the selection of language more accurately describing 13,200-volt energy than the words "low tension," as now commonly applied by those whose idea of "high tension" is perhaps 110,000 volts and whose duties bring them, through remote control, in daily contact, so to speak, with the lower potential.

Operating Features of Centrifugal Pumps

CENTRIFUGAL pumps have come into extensive use, owing to the simplicity of their parts. The centrifugal pump is ordinarily devoid of valves or opening and closing ports. It consists essentially of an inverted-action water turbine. A rotary impeller receives the water through a suction pipe, at a certain internal diameter, and delivers it at a larger external diameter and velocity. The energy of motion absorbed by the rotating impeller is delivered to the water in terms of the head. In order that such a pump may operate without undue energy loss, the geometrical forms given to the blades of the impeller must be such as will cause the rotary energy to be absorbed by the water smoothly and without shock. This can occur only when the angular velocity and the total head of delivery just satisfy the required conditions. Any one pump may be able to work over a wide range of speeds and heads, but in order to work at the best efficiency, suited to its proper design, there is only one proper driving speed and one total head. In general, therefore, a change in head or a change in the rate of water delivery calls for a change in speed of driving, if approximately the best efficiency is to be secured. Otherwise, if the speed is to be kept constant, a change must be made in the design proportions of the pump. When centrifugal pumps are driven by electric motors, and particularly by alternating-current motors, the speed is fixed within fairly narrow limits. This makes it difficult for the centrifugal pump designer to meet wide ranges of demand in delivery of water quantity and head. It is manifestly most economical to con-

struct as few designs and types of pump as possible, and yet, if the demand for a certain rate of pumping up to a certain lift happens to fall between the speeds for which motors are available, a new design of pump may be specially demanded.

Steam-Plant Efficiency

Many steam plants at the present time are installed with provision for bonus or penalty in case the contractor exceeds or fails on the specification undertaken. In other words, it is not unusual at the present time, and particularly abroad, to buy a plant on a specification which requires a very exact test to determine the final payment. Under these conditions tests which are not accurate to the highest feasible degree are likely to work injustice. It is quite easy to test a plant to within 3 or 4 per cent and extremely difficult to test it to 1 per cent, yet when one considers the amount of money involved in 1 per cent of needless error he realizes that something more than approximate methods are necessary. One point which has often been mentioned in the ELECTRICAL WORLD is the advantage of boiler and furnace design with relation to the fuel used. In a paper presented recently before the (British) Institution of Electrical Engineers, Mr. W. M. Selvey emphasized the fact that a boiler and furnace does its best work on a particular grade of fuel. Fuel better or worse than this standard of excellence handicaps a plant so that it may even happen that an admirable boiler and furnace will do rather badly on a lot of coal which from its analysis and general properties might be expected to give first-class results. On the electrical side of the problem the suggestion that efficiency tests should be conducted under conditions insuring unity power-factor whenever practicable is one to be taken rather seriously. There are cases in which, for one reason or another, tests at some other power-factor have to be made, but it is usually decidedly preferable to operate as near as possible to unity power-factor merely to facilitate precision in the electrical measurements. To be certain of high precision when measuring energy at a low power-factor requires an enormous amount of care. It is a safe general rule in testing of every kind to eliminate variables as far as possible and to make the correction factors as small as possible. In most cases they cannot be dropped out of sight entirely, but they can be brought to a point where the outstanding errors of measurement will not be serious.

Mr. Selvey made a sensible suggestion concerning the design of the condenser system. There is a tendency to operate condensers too near the limit in the interest of low first cost. If a condenser is to be depended on to operate at the highest efficiency, it is not safe to run it so close to the limit that a small but perfectly possible change in the temperature of the water or in the suspended matter it carries may seriously damage the vacuum. Turbo-generator plants in particular depend for high economy on exceptionally good condenser performance, and we quite agree with Mr. Selvey that money invested in a condenser capacious enough to run for long periods without exceptional trouble in cleaning is well spent. The author made note of the fact that turbo-generators in particular should carry their commercial load for some little time before being tested because some turbines have shown at least a 5 per cent better efficiency shortly after installation than at a later period. Hence it seems desirable to subject the machine to real service for some little time and then test it, after ample opportunity has been given to inspect the machine to make sure that it is in suitable working condition.

The Seattle Steam Auxiliary

Elsewhere in this section is printed a description of the admirably designed new steam station of the Seattle City Lighting Department, which has been installed as an auxiliary to its water-power plants. The present station is adjacent to the small water-power plant and operates in parallel with it. In fact, the hydraulic equipment is controlled from the switchboard in the steam station. The first unit of the new plant was placed in operation a few months ago. It represents advanced practice in several interesting particulars. In the first place, the boiler equipment is in four units, each of nearly 1500 actual horse-power. The furnaces as at present used are provided with complete oil-burning equipment, although room is left in the boiler setting to install automatic stokers in case it should be desired to use coal at some later time. The boiler equipment feeds steam to a single turbine with a nominal generator rating of 7500 kw, but deliberately designed to carry from 10,000 kva to 12,000 kva under emergency conditions.

The design of the turbine is such as to give maximum economy at 7500 kw, and above that point the load can be forced at the peak by admitting high-pressure steam to the intermediate stages of the turbine. The boilers are able to generate the necessary steam. In fact, the three boilers now in use have gone to 8100 kw without an excessive temperature rise. An attempt has been made in this equipment deliberately to push the generating equipment far over its normal rated output at times of peak—in fact, as far as the safe temperature conditions will permit, losing a little in efficiency if necessary, but yet giving good economy under rated load conditions. At full load the turbo-generator is guaranteed for 12.95 lb. of steam per kw-hr., a very good record for a unit of this size.

The generator is of the two-phase, instead of the more usual three-phase, type, much of the distribution being by single-phase feeders. The main water-power supply of the city is thus relieved by the steam plant, which is able to carry the heavy winter peak; in fact, during the first month of operation of the steam plant a period of extremely low water well proved its value. The present single unit can even carry the full load of the system in case of accident to the water-power, and the increasing load renders it likely that its equipment will be enlarged to serve as a complement to the pending increase in the main hydroelectric plant.

Oil-Burning Steam Station in Seattle, Wash.

Auxiliary Turbine Plant of the Seattle City Lighting Department on Lake Union—Station Wall Area Almost All Glass

THE first unit of the new 7500-kw auxiliary steam generating station of the Seattle City Lighting Department was placed in operation Sept. 6, 1914. The station is on the east shore of Lake Union between Fairview and Eastlake Avenues at the foot of Nelson Place. The site is adjacent to the Lake Union water-power auxiliary of the Lighting Department

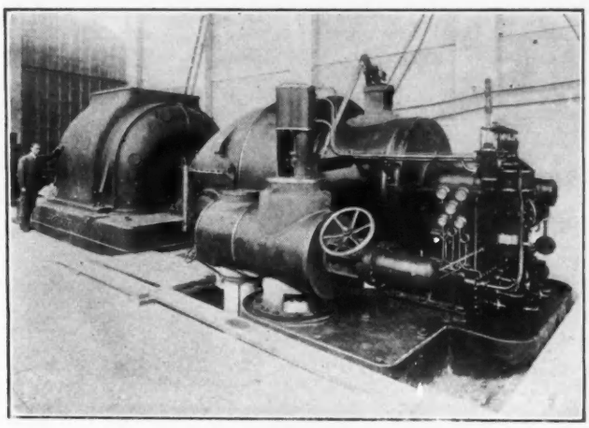


FIG. 1—STEAM-TURBINE UNIT

built in 1911 and is near the geographic center of Seattle. Lake Union furnishes an unlimited supply of water for boiler-feed and circulating purposes. With the completion of the Lake Washington canal oil or coal may be brought directly to the plant by steamer. At present the plant receives fuel by oil truck and by the Lake Union belt-line railway. A first-class apartment and residence district is on the hill above the plant, while along the lake shore are factories which may be supplied with steam for heating and industrial use.

Station Building

The building is of reinforced concrete, designed and built by the Department of Buildings of the city of Seattle. Its most striking feature is the open, daylight appearance inside, due to the fact that all the space between columns is occupied by windows. The building is 98 ft. 6 in. by 89 ft. with basement floor 19 ft. 3 in. below the Eastlake Avenue sidewalk, main floor at the sidewalk level and roof 45 ft. above the main floor. The generating unit, carried on a foundation entirely independent of the building, is installed on the Eastlake Avenue side of the building, on the main floor. The boilers occupy the Lake Union side of the same floor, while the condenser and auxiliaries, with the transformers and oil switches, are placed in the basement. The footings of the building rest on piles driven 30 ft. into the clay and gravel which forms the subsoil in this district. A concrete retaining wall extending 23 ft. below the street and containing 810 cu. yd. protects the building from possible sliding of the hill above Eastlake Avenue. All floors are designed for a load of 600 lb. to the square foot except the firing aisle, which is designed for 300 lb. The roof is of thin concrete steel slabs supported on steel roof trusses. The cornice is concrete with red paving brick inset for ornament. Practically all of the wall area is glass. An idea of its extent may be gained from the fact that 2.5 tons of putty were required to fasten it to the steel sash. A Whiting crane of 25 tons capacity and 30-ft. span is placed over the turbine room. The northwest floor panel of this room is provided with a removable steel floor plate so that apparatus may be lowered into the basement by the crane.

Boiler Room Equipment

Three 822.6-hp Stirling boilers, guaranteed for continuous operation at 180 per cent of normal load, or 1480 hp, are installed. These boilers operate at 77 per cent efficiency at full load. The fourth boiler is to be added immediately. The boilers are placed two in a bank, and each bank has a 90-in. steel stack extending 170 ft. above the boiler-room floor. Oil-burning equipment is installed with Lehigh burners. The boilers are set high enough to permit stokers to be inserted in case it is desired to burn coal, and the stoker tracks are installed. Room is left in the basement for ash hoppers and cars, so that the coal-burning equipment may be put in with a minimum of expense.

Oil-storage tanks have been erected on the lot next to the boiler room and behind the water-power station referred to above. They consist of two horizontal 15,000-gal. cylindrical steel tanks—the maximum allowed by city ordinance—and one cylindrical service tank 7 ft. in diameter by 24 ft. long, divided into two sections by an oil-tight diaphragm. These tanks are placed in a concrete inclosure and separated by a concrete wall and are buried under 4 ft. of earth. Connection

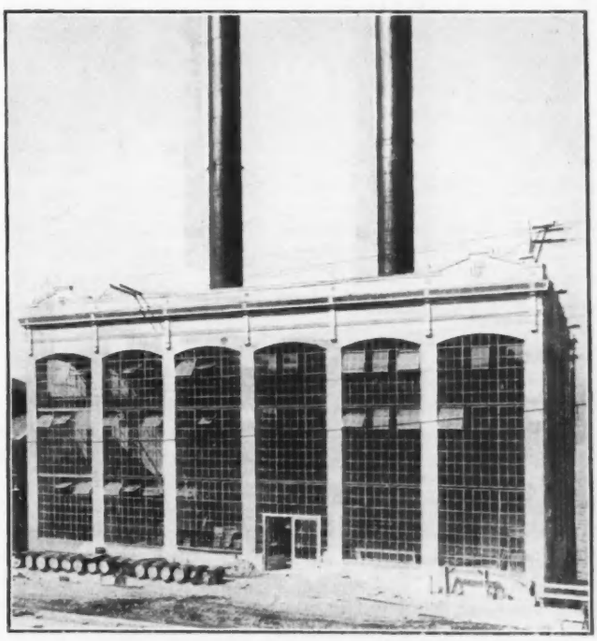


FIG. 2—EXTERIOR FROM EASTLAKE AVENUE

is made from each tank to each of two motor-driven, double-acting, duplex, inside-packed oil pumps made by the Fairbanks-Morse Company, rated at 16,000 gal. per hour and installed in the basement under the boilers, directly opposite the tanks. An 8-in. suction header is installed with the piping arranged for pumping oil from the oil truck on Eastlake or Fairview Avenue, or from

oil barge or tank car. For the accurate measurement of oil scales will be installed on which a tank wagon may be weighed before and after unloading or on which a tank may be placed for receiving oil from a barge or a tank car. Oil is drawn from the service tanks by burner-oil pumps on the boiler-room floor back of the boilers, where also are placed the oil heaters. Uehling carbon-dioxide recorders are being installed with chart in the turbine room and with indicator in the fire room, to enable the fireman to regulate his burners to the most efficient and smokeless flame. The plant is designed especially for a complete system of records, and recording as well as indicating instruments are supplied for the measurement of CO_2 gas, temperature of flue gases, temperature of superheat and feed water, steam flow, feed-water flow and everything from the oil to switchboard feeders.

Water Supply

Feed and circulating water is taken from the lake through a 30-in. intake extending 120 ft. out into the lake and leading through a concrete screen box at the west side of the building to the cold well at the end

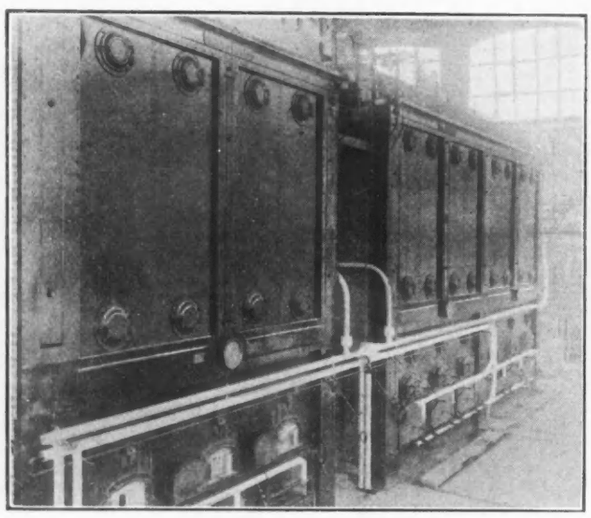


FIG. 3—BOILER ROOM

of the condenser, whence the circulating water is drawn. A Cochran 2500-hp heater with V-notch recorder is placed in the basement of the turbine room next to the boiler-feed pumps. The boiler-feed pumps, in duplicate, are multi-stage centrifugal units made by the Platt Iron Works, each driven by a 100-hp Terry steam turbine. The boilers are designed for 200 lb. pressure, and Foster superheaters are placed between the first and second banks of tubes to give 125 deg. superheat. The boilers are connected to a 12-in. superheated steam header, whence a 10-in. tap is taken to the turbine. The header is on a platform in the basement under the back of the boilers, and the turbine tap runs under the floor. General Electric indicating steam-flow meters are installed on each boiler, and a recording meter of the same type records the steam supplied to the turbine.

Steam Equipment

The generating unit consists of an Allis-Chalmers-Parsons turbine operating on 190 lb. pressure at 125 deg. superheat, directly connected to an Allis-Chalmers 7500-kw, 2500-volt, 1800-r.p.m., two-phase generator. This set is rated on a 50-deg. rise in temperature and is guaranteed for continuous operation at 11,720 kva at 80 per cent power-factor with 65 deg. rise. The turbine is guaranteed for a steam consumption of 12.95 lb. per kw-hr. at 7500 kw output. It is designed for maximum economy at full load, or 7500 kw, at which point an auxiliary valve admits high-pressure steam directly to the intermediate stage of the turbine. Lubrication is insured by a circulating-oil system which is mounted on the turbine itself.

A Wheeler rectangular jet condenser is suspended directly beneath the turbine. This condenser gives 28½ in. vacuum referred to a 30-in. barometer when condensing 97,500 lb. of steam per hour. Circulating water is supplied through an 18-in. inlet from the cold well. The circulating and air pumps are mounted on the same shaft directly beneath the condenser and are driven by a 225-hp Terry steam turbine. The air pump is a Wheeler turbo-air pump of the new rotary hydraulic type. Circulating water is drawn in by the vacuum and discharged by the centrifugal circulating pump. In starting, a jet of water from the city mains is used to condense the steam and start the vacuum. City water is also piped to the feed-water heater for boiler use if desired and is piped wherever needed throughout the building. A service pump of 400 gal. per minute rating, driven by a Terry turbine, supplies water to the feed-water heater from the hot well, which

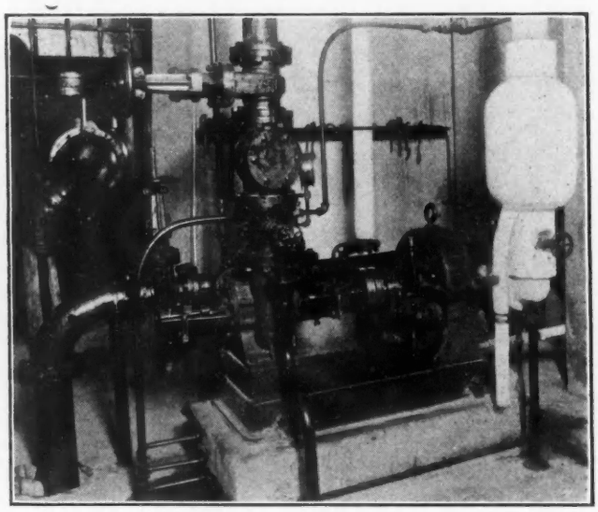


FIG. 4—SERVICE PUMP

is a concrete tunnel 4 ft. wide by 10 ft. deep, discharging through a 30-in. cast-iron pipe at the west wall of the building.

All auxiliaries at present operate from a 4-in. auxiliary header but are made for superheat if it is desired so to connect them later. This system was chosen from the standpoint of reliable service rather than extreme efficiency. The same idea was followed throughout the plant. The plant is expected to give 245 kw-hr. per barrel of oil of 6,216,000 lb. Fahr. thermal units per barrel in the tests soon to be conducted.

Electrical Equipment

The generator is of the revolving-field type, totally inclosed and ventilated by forced circulation of air, which is drawn through a duct from outside the building into the machine from below and discharged into the turbine room from the top of the machine. Excitation is furnished at 125 volts by a 2500-r.p.m. Allis-Chalmers turbine-driven exciter of 50 kw rating, which is installed in the turbine room next to the main set. The generator has eight resistance elements placed in the slots back of the coils, which are connected to a resistance thermometer on the switchboard so that the operator may know the exact temperature of the hottest part of the generator at all times.

The generator is installed with the expectation that

it will deliver 10,000 kw. On the three boilers now installed it delivers 8100 kw maximum with a temperature rise of less than 20 deg. over peaks. An attempt was made to rate the machine on the total temperature allowable, which was established at 90 deg. C., and the resistance coils placed in the hottest parts of generator coils were to determine this temperature, which the resistance thermometer on the switchboard will not be allowed to exceed. The carrying capacity of the generator will now depend on the temperature of the incoming air, and the air duct is carried out of the building to the coolest point available. It is the intention of the department to adopt this system of rating and temperature control on all machines in future, since the output of a machine is what it will deliver and not what it is rated at. The generator is connected through

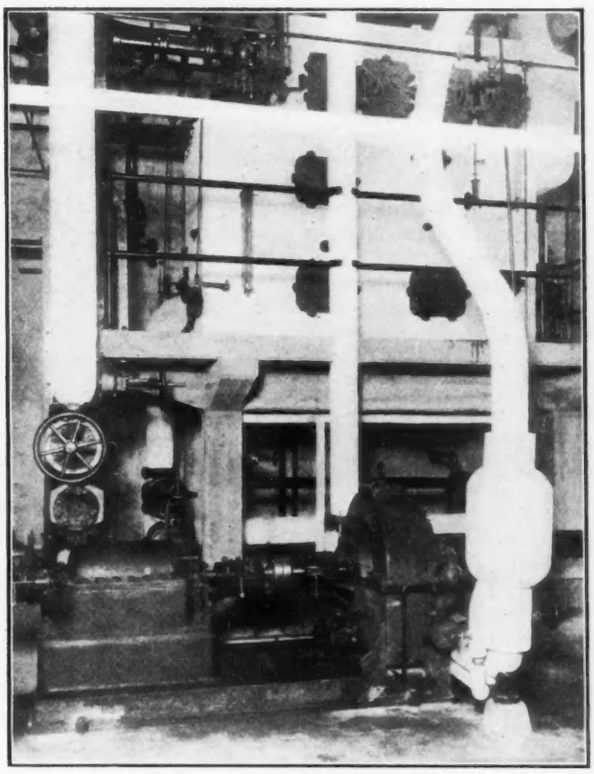


FIG. 5—FEED-WATER HEATER AND BOILER-FEED PUMPS

reactance coils in each phase. These coils are made by the Westinghouse Electric & Manufacturing Company and give 5 per cent reactance drop on full load. They are mounted in the concrete pier on which the generator rests.

The station will be used both as a generating and a distributing station and operates in parallel with the water-power station adjacent to it. This water-power station has already been described in the columns of the ELECTRICAL WORLD. It delivers 1500 kw to 1800 kw from the overflow of the Seattle water system and will be controlled from the steam plant switchboard. Provision is made for four 15,000-volt lines from the station and two two-phase and six single-phase, 2500-volt feeders, besides two 2500-volt, two-phase tie lines connecting with the main substation at Seventh Avenue and Yesler Way. The step-up transformers are of the Allis-Chalmers water-cooled type in welded boiler-iron cases. They are rated at 9400 kva per bank of two and guaranteed for 14,100 kva per bank for two hours. One bank of two is installed, with one spare transformer. They are installed in the basement on the lake side, and the generator, transformer and line oil switches, with concrete cells and bus structure, are to be installed in the same room. Provision is also made for feeder regulators for the 2500-volt feeders, and for the necessary disconnecting switches and instrument transformers. This electrical apparatus will be separated from the ash-handling equipment and the steam piping by a concrete wall. Lightning arresters for the 15,000-volt lines will be installed in the space back of the water-power station over the oil tanks.

The switchboard, of Monson slate, 32 ft. long and 7.5 ft. high, is placed in the turbine room parallel to Eastlake Avenue. All apparatus is remotely controlled, and 125 volts is the maximum potential on the switchboard. Control for both the water-power plant and the steam plant is placed on this board so that both plants are under one operator.

Purpose of the Steam Plant

The steam plant is intended as an auxiliary to the water-power station at Cedar Falls. It will be used to help carry the heavy winter peaks, which now are above the present capacity of the Cedar Falls plant, and to help supply energy through a possible low-water season, as well as to be ready to take its full load any instant in case of accident to the water-power plant or transmission system. It thus serves as a general safeguard and guarantee of the city's service as well as an addition to the system. Although danger from low water is not anticipated on account of the completion of the new Cedar River dam, the steam plant has already proved its value as an auxiliary. The water in Cedar Lake during September was abnormally low, and but for the timely completion of the steam station the water plant would have been overtaxed. The building was begun on April 28 and the station was delivering energy on Sept. 6. Its cost to date has been $241,000. There will be some additional expense, but the cost properly chargeable to the steam plant, it is said, will be less than $300,000.

So rapidly has the load on the city plant grown that a new concrete dam has been built at Cedar Falls at a cost of $1,500,000, which increases the storage so as to admit of a final development of 40,000 kw. It is planned to install the first 10,000-kw unit of this new development in the near future. Mr. J. D. Ross, superintendent of lighting, is in charge of the Seattle municipal plant.

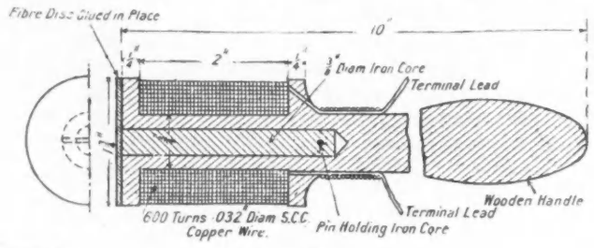
Presence of Salt Indication of Other Impurities in Boiler Water

At one of the large generating stations in New York City where salt water is employed to cool the condensers condensate is tested every hour to determine whether any salt is present. If any is found, it indicates that the condensers are leaking and must be immediately attended to or all of the boiler water will be contaminated. The test is also valuable in that it forewarns when additional feed-water compound may be required to precipitate impurities which are carried into the boilers along with the salt. Not only is the condensate tested but also the boiler's contents. This, however, is done only once a day as leakage of scale-forming compounds into the feed-water system is usually noted by analysis of water from the condensers. The standard titration test of adding silver nitrate to the water is employed. This is much simpler than testing for the presence of other impurities. To remove scale-forming impurities from the water it is treated by adding sodium carbonate and the precipitate is removed by blowing off the boilers when the fires are banked.

POLARITY TESTER

Convenient Device for Locating Faults in Motors and Generators

The accompanying illustration shows a simple and reliable polarity tester used by the British Westinghouse Electric & Manufacturing Company on the test floor. An ordinary search coil, preferably with a small iron core and completely insulated on the outside, is used. The coil is fastened to the end of a wooden handle and



POLARITY TESTER

flexible wires connect the ends of the coil to the terminals of a direct-current millivoltmeter. If the coil is moved toward a magnet, a certain electromotive force is induced in the coil and the needle of the millivoltmeter shows a momentary deflection. A greater deflection can generally be obtained if the coil after being carefully brought quite near to the pole is quickly withdrawn. Naturally, the direction in which the needle moves depends on the polarity of the magnet from which the coil is withdrawn. If it is withdrawn from a north pole, the needle will move say to the right, and if withdrawn from a south pole, to the left. Thus, by testing all the poles in rotation, it is possible to ascertain whether the connections have been made correctly or incorrectly.

If the armature of a six-pole generator is rotating in a clockwise direction, then the commutating pole which stands in the position corresponding to the 11 o'clock mark of the clock should have the same polarity as the main pole corresponding to the 12 o'clock mark and so on all the way round. On the other hand, each commutating pole of a motor should have the same polarity as the main pole preceding it in the direction of rotation.

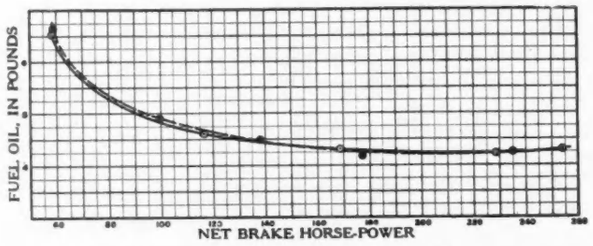
With a six-pole motor running in a clockwise direction, the commutating pole in the 11 o'clock position should have the same polarity as the main pole in the 10 o'clock position. Perfectly satisfactory results are obtained by keeping the search coil to a part on the poles near the yoke where there is no danger of accidental contact with the rotating part, but care must, of course, be exercised to see that no part of the flexible cord touches any part of the rotating machine. Sometimes the commutating poles of a machine show correct polarity when there is a good load on the machine but behave irregularly on light loads, and this may be due to slight irregularities in the mechanical construction of the machines. If a commutating pole is not in the center of its neighboring poles, but is nearer, say, to the main north pole than to the main south pole, then the commutating-pole tip will show south polarity without any current going through its windings, and therefore, with a very light load, the current passing through the commutating-pole winding, and tending to make the pole, say, a north pole may not be strong enough to overcome the polarity caused by the unequal setting. The same thing will occur if the air-gap between the armature and north pole is smaller than that between the armature and south pole.

The search coil is of considerable assistance in making accurate magnetic adjustments, which is, of course, necessary in order to secure good commutation. It discovers the reasons for imperfect commutation in a simple and convenient way, and should prove very useful to those who have to locate faults in electrical machines. The search coil gives in many cases quite reliable results even with the machine not running, the residual magnetism being strong enough to cause with quick movement of the coil a small but distinct reading on the millivoltmeter scale. For instance, in an interpole railway motor, with the armature removed, the polarity not only of the main poles but also of the commutating poles could be determined. If the last direction of rotation is known, the polarity of the interpole gives a clear indication of whether the machine was last run as a motor or as a dynamo, and this may in certain cases serve to clear up points in connection with railway accidents.

When winding a search coil of given size it is advisable to take a wire of such diameter that the total resistance of the search coil corresponds approximately with that of the millivoltmeter, which is usually from 1 ohm to 2 ohms. For the test in the Westinghouse works a coil has been used with an outside diameter of 1.75 in., inside diameter of 0.75 in. and 2 in. long, the core consisting of a 0.5-in. iron rod 2.50 in. long. The spool is wound with 580 turns of single cotton-covered wire, 0.032 in. in diameter and giving a total resistance of approximately 1.5 ohms. If a thinner wire had been used, the advantage gained by increasing the number of turns would not have outweighed the disadvantage of increasing the resistance. But, after all, the disadvantage of high resistance simply means that the deflection of the needle is reduced. Quite useful results can be obtained with a wide range of coil resistance. If no millivoltmeter is at hand, then a moving coil ammeter with the shunt disconnected may be employed. A low-reading voltmeter—1 volt or 3 volts—may also give distinct readings, but in this case the search coil must be wound with many turns of the thinnest wire, because the internal resistance of a 1-volt or 3-volt instrument is several hundred ohms. A very suitable instrument to use is a Weston galvanometer, which is very sensitive. In some cases a search coil with an outside diameter of 1.75 in. may be too large to reach every pole, but if a millivoltmeter or Weston galvanometer is at hand, a smaller coil may be employed.

Diesel Efficiency for Steady and Fluctuating Loads

The accompanying curves compare the fuel consumption of a 225-hp Busch-Sulzer Diesel engine under conditions of steady and fluctuating loads. The tests were made by Dr. A. C. Scott, Dallas, Tex., at the plant of the Hugo (Okla.) Ice & Light Company, where the engine



FUEL CONSUMPTION UNDER STEADY AND FLUCTUATING LOADS

is employed to drive a 200-kva alternator. The fuel consumed contained 19,000 lb.-Fahr. heat units per pound of oil and cost 2.9 cents per gallon.

The solid curve traces values obtained under steady-load conditions, the engine being operated for three hours at each of the loadings indicated by the circum-

scribed points, viz., 58.2 hp, 116.7 hp, 168.6 hp, 228.5 hp and 254 hp.

For the second set of tests, the results of which are shown by the dotted line, the engine was started with a load of 36.2 kw, which at the end of the first half-hour period had been gradually increased to 62.4 kw. Similar load increases were made during each following thirty-minute period until a load of 170.4 kw was reached. At average full load the fuel consumption was at the rate of 0.425 lb. per net brake-hp-hr., or about 5.98 gal. per 100 net brake-hp-hr. At the price paid for oil, the fuel cost therefore represented only 1.75 mills ($0.00175) per brake-hp-hr.

AIR-SPACE AREA OF GRATES

Its Effect Upon the Temperature of Furnace Gases and the Efficiency of Fuel Combustion

By R. T. Strohm.

If the grate of a steam boiler had no other object than to serve as a support for the fuel, a firebrick floor resting directly upon the earth would probably answer the purpose; but in order that there may be efficient combustion, the combustible must be brought into intimate contact with oxygen, and this is most easily accomplished by causing air to pass upward through the bed of fuel. For this reason grates are made with openings instead of with unbroken surfaces. Again, the openings in the grate allow the ashes to drop out of the fire, thus keeping the fire clean.

As the principal purpose of the grate is to support the fuel, the air spaces must be of such size as to prevent the fuel from dropping through; or, in other words, the width of the air spaces must be determined by the nature of the fuel used. The coarser the fuel, the larger may be the openings for air.

At first thought it would seem as though the air spaces should form as great a proportion of the grate surface as possible, so that the amount of air admitted to the fuel bed might be large, to insure an ample supply of oxygen. But the greater the area of the air space, the width of the spaces remaining the same, the narrower must be the metal parts of the grate, and these cannot be made too thin without inviting trouble.

SIZES OF COAL USED FOR BOILER FUEL

Kind of Coal	Diameter of Ring		Square Mesh
	Over	Through	
Pea	5/8	15/16	5/8
Buckwheat	7/16	5/8	7/16
Rice	1/4	7/16	1/4
Barley	3/32	1/4	3/32

In the first place, it is difficult to cast grate bars if the thickness of the metal is made very small. The sand that forms the air openings is apt to bake and crack and thus allow fins to span the air spaces; also, in cooling, the thin metal parts are very apt to break away from the heavier parts of the bar.

As a consequence, it has not been found wise to attempt to make the metal sections very thin. A thickness of 1/4 in. at the fire surface is probably the usual lower limit. To make the pattern draw easily from the sand, the webs are made thinner at the bottom; but these thinner parts are not exposed to the direct action of the hot fuel. Another objection to the use of very thin webs is the trouble that may ensue through warping under the effect of heat.

The sizes of anthracite used for steam-boiler fuel are pea, buckwheat, rice and barley. The actual sizes of these grades, however, depend on the nature of the screens through which they are run. The accompanying table gives the approximate sizes of the several kinds. In other words, the buckwheat size will pass over a screen having 7/16-in. round holes and through one having 5/8-in. round holes. The same size will pass through a 7/16-in. square mesh, but over a 1/4-in. square mesh.

Anthracite is a fuel that contains a very small percentage of volatile matter, and to insure successful combustion the pieces should be of approximately the same size, as the air can then most easily pass through the voids. It is for this reason that coal is sized by screening.

In selecting a grate to burn any one of these sizes of anthracite, therefore, the width of air openings should be less than the diameter of the screen opening through which that size of coal will pass. This is necessary in order to prevent waste of unburned fuel. The ratio of air space to grate area, however, is not fixed by any arbitrary rule. As a usual thing, the width of the air space and the thickness of metal in the grate bar are made equal, so that practically half of the grate area represents air-opening area. In some types of grates the percentage of air space is even greater than 50 per cent.

It is well to bear in mind the fact that a large percentage of air space is not an absolute necessity, and that instead of serving to increase the efficiency of combustion, it may operate to produce the opposite effect. This is explainable on the grounds of excess air admitted to the furnace.

One of the most common faults in the firing of steam boilers is the admission of too much air, with the result that the temperature of the furnace gases is lowered and their quantity is greatly increased, causing a loss of heat. By reducing the amount of opening through which air can enter the furnace, as by decreasing the width of air spaces in the grates, the furnace temperature is raised, the gases are in contact with the boiler for a longer period, and a greater percentage of the heat generated is utilized in making steam.

The extent to which cutting down of the air space may be carried is limited by the nature of the draft. With natural draft considerable area is required to admit the necessary air supply. With forced draft it may be possible to reduce the air-space area to a small fraction of the grate area. One writer, in describing the use of low-grade anthracite with a forced draft of from 3 in. to 5 in. of water, states that grates containing as low as 5 per cent of air space are in use. This means, of course, that the velocity of air through the grates is correspondingly large.

It is extremely doubtful whether bituminous coal could be burned properly under such conditions. The volatile matter is given off during the early stages of combustion of the green fuel, and to insure efficient burning it must be thoroughly mixed with air before it is cooled to a temperature below the igniting point. This necessitates the admission of air above the grate in addition to that which enters through the grate.

Now, in certain tests of boilers using bituminous and semi-bituminous coal, it has been found that a reduction of the air space in the grate has been followed by increased efficiency of combustion. The reason for the better performance may have been the cutting down the air supply from a previously excessive and wasteful amount to a more nearly normal amount; or possibly the restriction of flow through the grate caused a greater amount of air to be drawn in above the grate,

where it would be of greater value in burning the gases. Air could enter above the grate by passing through the openings in the firedoors and boiler front, past the joints of the doors, and through the brick setting of the boiler.

Automatically Maintaining Constant Ratio Between Air and Coal Supplied to Furnaces

In the Gold Street generating station of the Edison Electric Illuminating Company of Brooklyn there is apparatus for automatically maintaining a constant ratio between the coal and air supplied to the furnaces under all loads. This is done by changing the speeds of the turbine-driven blowers and mechanically operated stokers simultaneously with fluctuations in steam pressure. As two sets of blower units are installed at each end of the firing aisle and as separate stoker engines are employed with each set of eight boilers, it is necessary to control the driving units from a shaft extending the full length of the boiler room. This shaft is operated by a hydraulic piston the position of which is determined by a diaphragm connected with the main steam header.

The arrangement and connections of the equipment are shown in the accompanying illustration and line drawing. To prevent live steam reaching the pressure diaphragm the pipe leading to it is bent in the shape of a long U which is kept full of water. The diaphragm acts directly on a lever which bears against a knife edge at one end and is counterweighted at the other. Attached to the lever is a rod which operates a pilot valve admitting water to hydraulic apparatus operating the control shaft. This in turn is connected with the

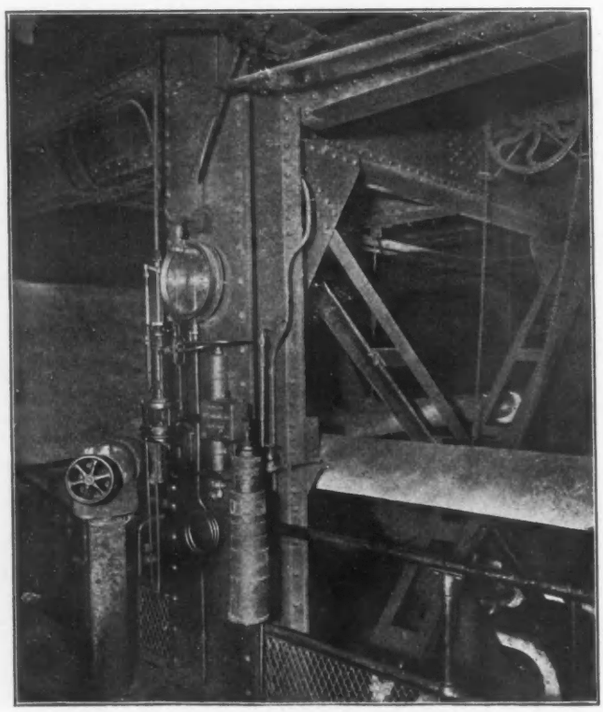


FIG. 1—APPARATUS CONTROLLING FURNACE BLOWERS AND STOKERS

throttles of the stoker engines, the shunt-field rheostats of the stoker reserve motors, and the regulating valves of the blower turbines.

When the steam pressure rises water is admitted to the lower end of the hydraulic cylinder and that in the other end is allowed to discharge. As the control shaft turns the blowers and stokers decrease in speed until the pressure drops to normal, when the pressure valve prevents further movement of the hydraulic piston. A drop in steam pressure causes the reverse action to that described. An abrupt change in steam pressure causes the hydraulic piston to move more quickly, thereby

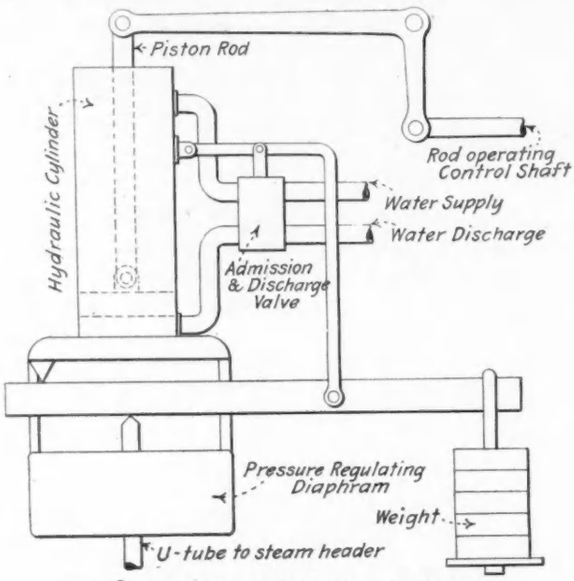


FIG. 2—DETAILS OF CONTROL APPARATUS

changing the blower and stoker speeds more rapidly. This apparatus has been in use for some time, and it is reported that the boiler-room efficiency has been maintained very satisfactorily thereby.

Advantages of Large Steam Condensers

According to a prominent English engineer the effect of vacuum on turbines is so great that a given weight expended on the condenser end is far more profitable in power production that a similar weight expended at the boiler end. The aims of an efficient condenser are to have the maximum of heat transferred from the steam to the circulating water—that is, a minimum difference between the temperature due to the vacuum and the temperature of the circulating water leaving the condenser—and also to deliver the condensate to the hot-well as near the temperature due to the vacuum as possible. And here it is important to consider the steam consumption of the auxiliaries and the air-withdrawal arrangements, which comprise air pumps in some form, together with the withdrawal of the condensate from the condenser. As the driving power of air pumps is at most only about 1 per cent of the power of the turbine at full load, and in general much less, the importance of the steam used per unit of power required for driving an air pump is negligible compared with its vacuum-producing qualities. The steam required by the circulating pumps depends on the steam consumption in pounds per water horse-power-hour of the engine driving the circulating pumps, the ratio of the circulating water to the steam condensed, and the total head on the pumps.

Without allowing for condensation it may be said that in this case the temperature of the feed, after it has condensed the steam from the circulating pump, is largely independent of the quantity of circulating water, and this has to be considered in making up the final balance sheet, which alone enables the most difficult problem of the best vacuum to be solved.

Electric Motor Drive of a Large Flour Mill

Method of Interlocking Machines for Simultaneous Operation in the New Plant of the Commercial Milling Company, Detroit, Mich.

THE new flour mill of the Commercial Milling Company, Detroit, Mich., which is one of the largest and most up-to-date installations in the country, is now operating entirely with electrical energy generated in the company's private steam plant. A single turbo-generator is relied on to furnish energy for the entire mill, there being no emergency generating apparatus or throw-over connection with the central-station company. The present mill is interesting because it is one of the first in this country to be equipped throughout with motor-driven apparatus. While most manufacturers have responded quite readily to the movement toward electrification of factories, owners of flour mills until now have been backward in adopting motor drive because of conditions which, inherent in the industry, have limited the extensive application of electric motors.

One objection to group motor drive in flour mills has been that all flour-making machinery must operate simultaneously, since otherwise the wheat in one of the stages of milling may choke up the entire system. Another objection has been that sparks at electrical contacts may cause an explosion of the flour dust which is generally present inside such a mill. The latter objection has been removed by using combination wound-rotor and squirrel-cage induction motors and by employing dust collectors wherever necessary. The first objection, which is really the most vital one in this industry, has been eliminated at the Detroit mills by electrically interlocking all group-drive motors connected to a consecutive set of milling machines. By installing motors near the machinery which they drive this company has avoided the use of long belt transmissions and countershafting, which are usually required in large steam-engine-driven mills unless several prime-movers are distributed about the building, as may be done easily with the motors.

All of the operations in this mill, including the unloading of grain boats, moving of boats, spotting of freight cars on private sidings, distribution of grain among elevators, milling and packing, are performed by motor-driven apparatus.

General Description

The flour mill, which is designed for an ultimate output of 2500 bbl. per day, occupies a structure built entirely of reinforced concrete and is 50 ft. wide, 353 ft. long and has a maximum height of ten floors. Milling machinery for producing only 1200 bbl. a day is installed now in one half of the building, the other half being reserved for future equipment. The mill is situated on the northern bank of the Detroit River, where grain can be unloaded directly from the Great Lake boats into the grain reservoirs, of which there are sixteen cylindrical-shaped and ten diamond-shaped, having altogether a total content of 275,000 bushels.

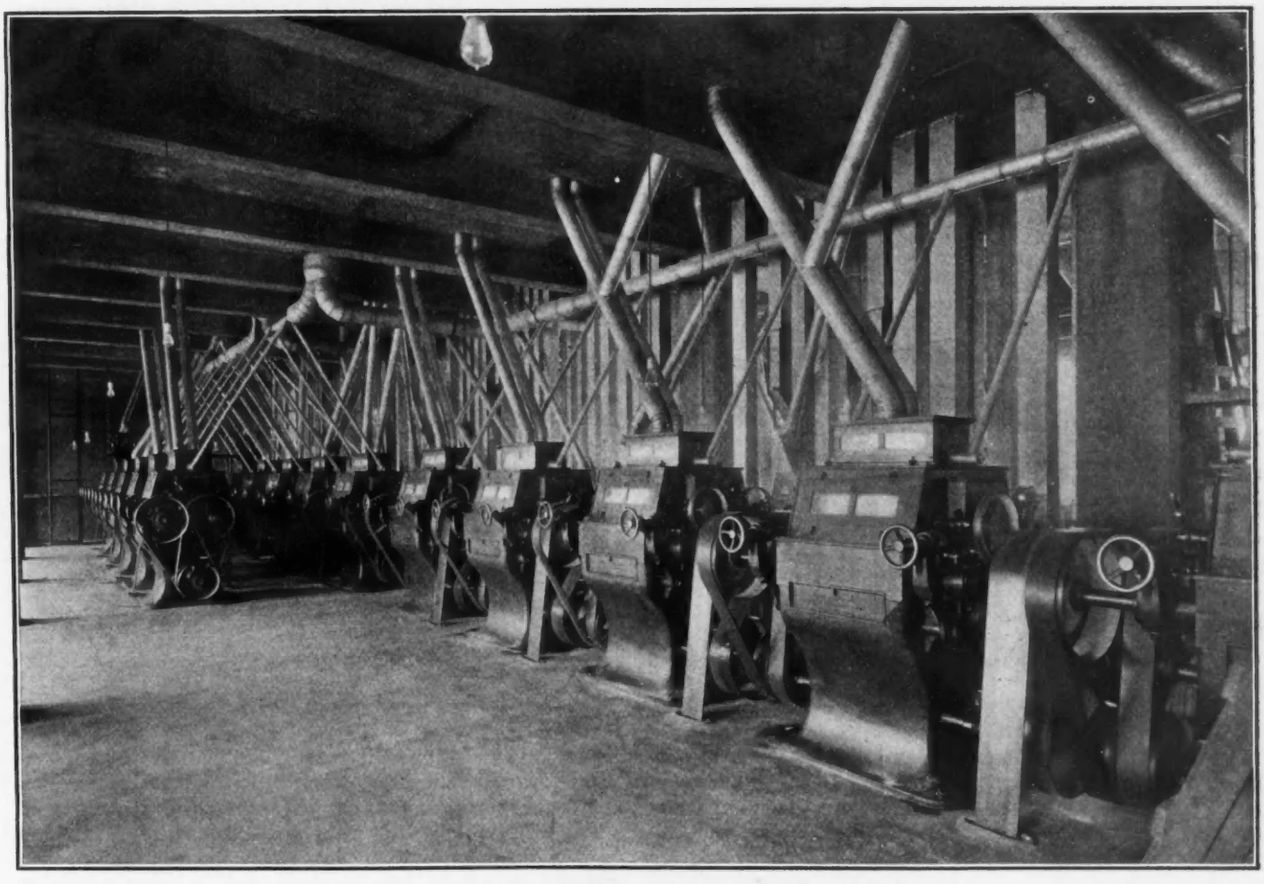


FIG. 1—FLOUR ROLLS DRIVEN BY A SINGLE MOTOR

A mammoth electric sign advertising the brand of flour manufactured is placed on top of the building on the river-front side so that persons on passing vessels and ferries as well as those on the Canadian shore can see it.

The boiler room contains a double-setting of 350 hp Edge Moor boilers equipped with steam-driven Jones underfeed stokers and Foster superheaters. From the storage space coal is conveyed to a 200-ton overhead hopper in the boiler room by an endless belt and a bucket elevator driven by a 15-hp induction motor. The latter also operates a crusher.

Connected with the boilers is a 7-in. header feeding three take-offs—one for the turbo-generator, the second for the auxiliaries and the third for steam heating. Steam from the auxiliary header is also used for drying and heating grain in the elevators.

Engine Room

In the room adjoining the boilers there are installed a 600-kw General Electric horizontal turbo-generator, a six-panel motor-feeder switchboard and several auxiliary engines. The turbine unit operates on 175-lb. pressure and exhausts into an Alberger Spiroflo condenser in the basement. Energy is generated at 480 volts and sixty cycles and distributed at the same pressure to some twenty-one motors having a total rating of about 930 hp. For the lamp circuits the generated pressure is stepped down to 220/110 volts by three 15-kva transformers.

The switchboard in addition to having generator and exciter panels contains four motor-feeder panels, one of which supports the feeder oil switch connected to the motors, which must be operated simultaneously. The accompanying diagram shows the scheme of interlocking the motors, which can be extended at any time to include more units. If one motor oil switch in the interlocked system opens owing to an overload or energy interruption all the rest will do likewise. This operation is effected by reconnecting the no-voltage relays and contacts on the feeder oil switch and on each motor compensator as shown. *A*, *B* and *C* represent the conductors of the three-phase motor circuit. Across one phase is connected a series circuit consisting of all the relay contactors, a series resistance and the no-voltage relay coil of the main feeder switch. The no-voltage coil on each motor control oil switch is connected in series with a definite resistance as shown, while the overload coils are connected as usual. Any relay contactor upon opening will thus trip the no-voltage relays on the other motors, either directly or indirectly, by first tripping the main oil switch.

Distribution System

All wires in motor and lamp circuits are inclosed in conduits which are run exposed along the ceilings, passing around the girders in most cases rather than through them. Porcelain clamp insulators are used exclusively for supporting the conduits. Metal distributing cabinets are employed, and where circuits enter them the holes are fitted with porcelain bushings to segregate the conduits and prevent the metal of cabinets from becoming energized by an accidental connection between a conductor and a conduit. The distributing panels are made of slate and all distributing switches are of the knife type.

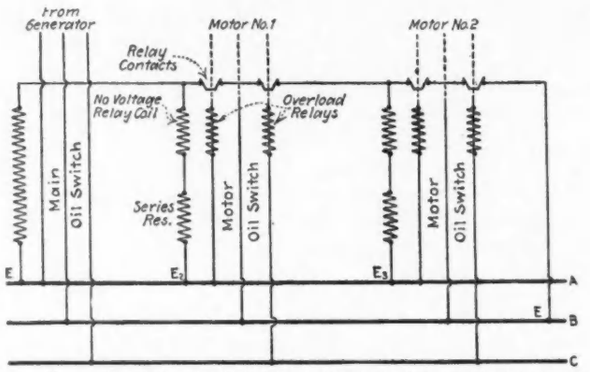


FIG. 3—DIAGRAM SHOWING SCHEME OF INTERLOCKING MOTORS

Grain Unloading

The apparatus for unloading the grain boats consists of an endless-chain bucket elevator supported vertically at the end of a movable cantilever beam so that its lower end may be lowered into the vessel's hatchway. The arm supporting the unloading apparatus is hinged at its lower end so that it may be folded up into a concrete tower at one end of the building. One 50-hp induction motor operates the grain-unloading elevator and also raises the cantilever beam, the former through a wire cable drive and the latter by a cable wound on a drum. The motor may be connected to drive either by shifting a clutch lever. Although the weight of the

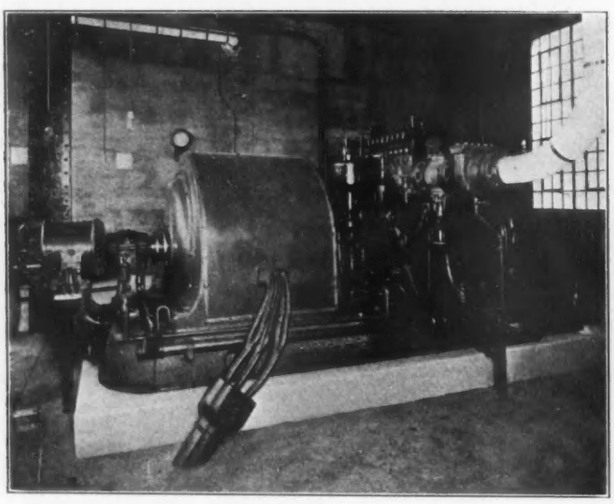


FIG. 2—TURBO-GENERATOR FURNISHING ALL ENERGY

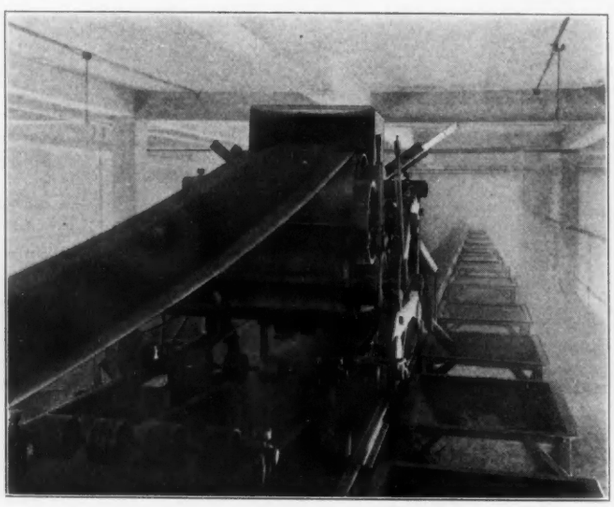


FIG. 4—CONVEYOR DISTRIBUTING GRAIN TO ELEVATORS

bucket elevator automatically lowers the supporting arm as the vessel's cargo is removed, men are employed to see that the lower end of the elevator is always surrounded with grain. The buckets scoop up the grain in the ship's hold and as they tip over at the top of their travel deliver the grain to a gravity chute (emptying into an automatic weighing hopper) which discharges

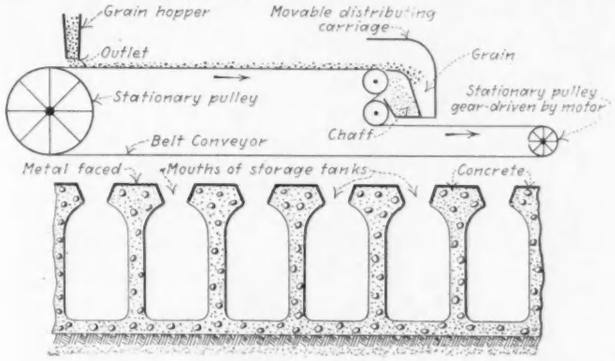


FIG. 5—MOTOR-DRIVEN DISTRIBUTING CONVEYOR OVER GRAIN TANKS

into an endless-belt conveyor running beneath the grain-storage tanks.

Belt Conveyors

There are two endless-belt conveyors in the building, the one just mentioned below the storage tanks which receives grain from the ships or freight cars by gravity chutes and another above the tanks which distributes the grain among the tanks. When grain is shipped by rail it is unloaded from the cars by motor-driven grain shovels and dumped into the gravity chutes discharging on the lower conveyor. A 5-hp motor operates the shovels, while the receiving conveyor is driven by a 15-hp motor. The latter transfers its charge to bucket elevators (belt-driven by a 100-hp motor) which deliver the grain to a hopper at the top of the building. From this hopper the wheat is fed into the distributing conveyor which removes the dust, chaff, etc., and then dumps the clean grain into any one of the twenty-six grain-storage tanks.

The distributing conveyor is shown in operation in an accompanying illustration. The conveyor belt extends the full length of the tank compartment, passing around pulleys of different diameter at each end and over two small pulleys in the distributing carriage as shown in the accompanying diagram. The belt is driven by a 10-hp motor geared to the smaller end-pulley. Grain is delivered on the upper run of the conveyor belt at the large-pulley end, and as the belt passes around the small pulley in the carriage the grain is thrown into the carriage hopper by its momentum, while the chaff which is lighter follows the belt temporarily and drops off into a separate compartment. The distributing carriage runs on a narrow-gage track over the tanks, and two chutes attached to the carriage at right angles to the track discharge the grain into the tanks below. The distributing carriage is moved along the track by transmitting the power delivered by the moving belt to the drive wheels through friction clutches.

As the grain is required for milling it is drawn off at the bottom of the tanks and delivered to a number of small bucket elevators which convey it to the top floor of the "cleaning" section of the building, where it is started in the process of cleaning. The purifying apparatus is grouped on different floors so that gravity can be employed to carry the grain through the machines in the proper order.

Distributed through the grain-cleaning section of the building are magnetic separators which remove any particles of iron or steel which may have collected in the grain. The latter then passes through oat separators, scouring machines, mustard-seed separators and other cleaning and purifying machinery. After passing through any machinery which loosens chaff or dust the grain is cleaned by a blast of air which deposits its burden in a dust collector. These dust collectors are conspicuous throughout the building.

After being cleaned the grain passes through automatic recording weighing hoppers and thence to governors which regulate the rate at which the grain is fed to the milling machines by small bucket elevators. There are sixty-three of these elevators, including those serving the cleaning section of the building. The grain to be milled is also conveyed to the top of the building by elevators after being cleaned and is delivered by gravity to the milling machines, which are arranged in the proper descending sequence. Among the machines through which the grain passes before it finally becomes flour are dividers, wheat heaters, bolters, purifiers, reels, graders, scrolls, bran and shorts dusters, mixers, rolls and packers.

The several grades of flour in their finished form are packed by motor-driven packing machines which weigh

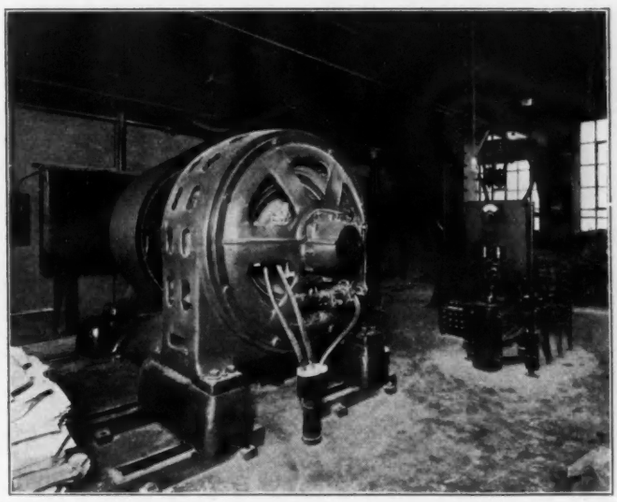


FIG. 6—300-HP MOTOR DRIVING FLOUR ROLLS

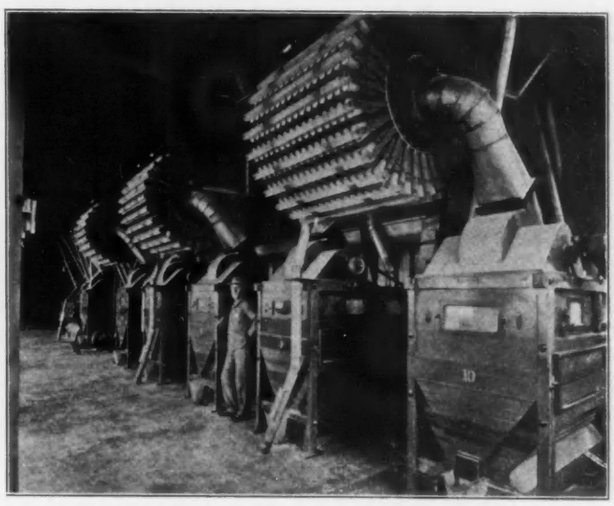


FIG. 7—GROUP-DRIVEN FLOUR PURIFIERS

FIG. 8—MOTOR OPERATING GRAIN UNLOADER

the flour and automatically shut off the flour chute until the next package is in place to be filled.

Motor Equipment

Very few pieces of machinery in the building are driven by individual motors, as on each floor there are several machines which perform the same operation and can consequently be driven economically in a group by one motor. The motors are placed so as to drive these groups with the least possible amount of shafting and belting. The accompanying table gives a list of some of the motors, their rating, the feeder circuits from which they are supplied, and the machines which they drive. All of the motors are of the 440-volt, sixty-cycle, three-phase induction type. The 300-hp, 200-hp and 100-hp sizes have wound rotors, whereas the others have squirrel-cage secondaries. The circuits to each motor are entirely inclosed in conduit, and the slip-rings on the three larger motors are short-circuited to prevent sparking when operating at full speed. Each motor is supplied from its individual distributing box, the squirrel-cage type being equipped with oil-switch compensators and the wound-rotor type with an oil-switch and starting controller. The 300-hp and 200-hp motors which drive through wire cables are also equipped with elaborate cable tighteners.

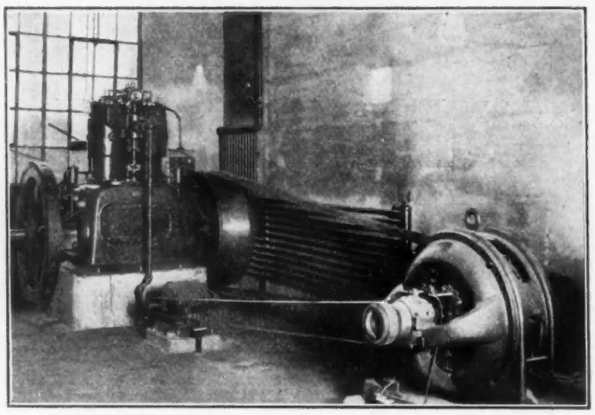


FIG. 10—GASOLINE-ENGINE-DRIVEN GENERATOR

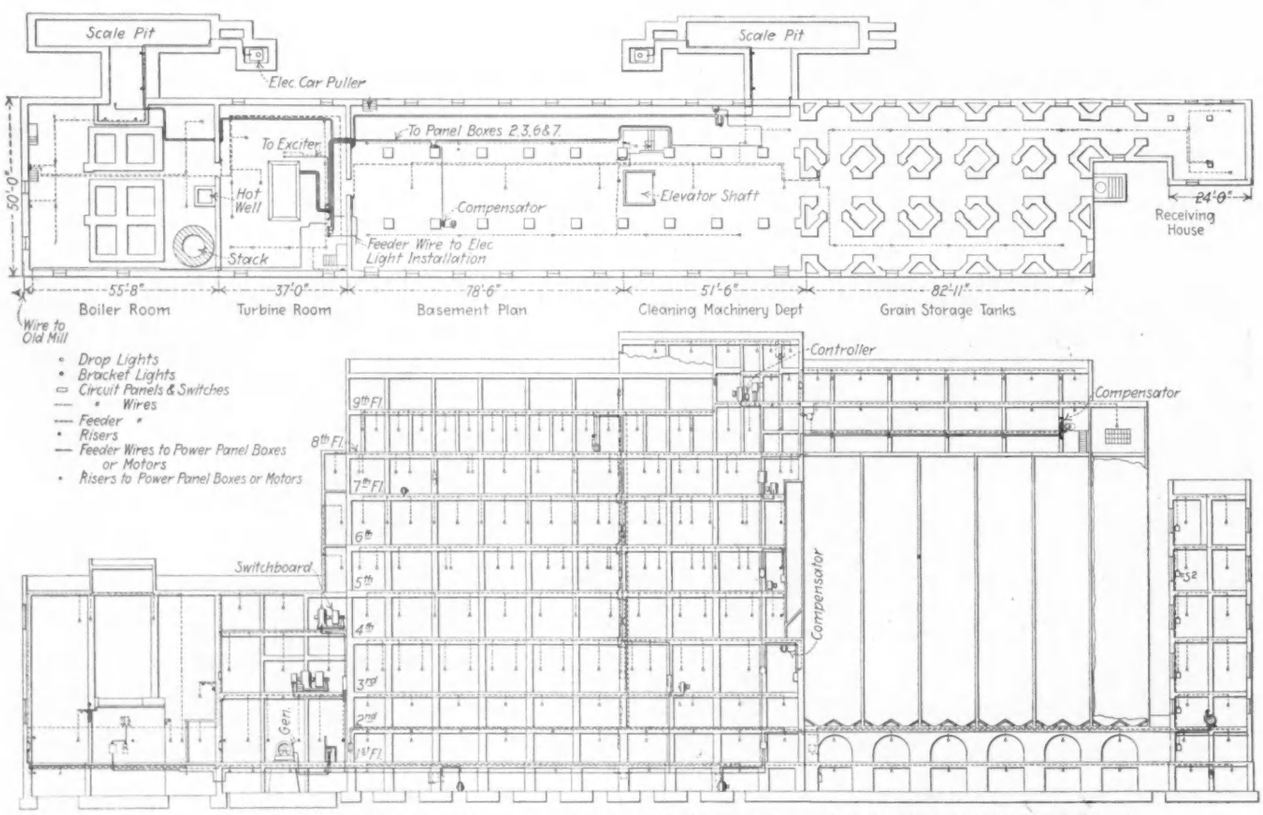


FIG. 9—PLAN AND ELEVATION OF FLOUR MILL, SHOWING LOCATION OF PRINCIPAL MOTORS

Mill Illumination

The equivalent of 650 25-watt tungsten lamps are installed in the new building. Bracket supports are used

in some parts of the building, while Holophane steel reflectors supported about 6 in. below the ceiling are used over the shipping platform. The ninth floor of the building will be devoted to office rooms and will be lighted more elaborately. All lamps under the scale pits, in the boiler room and outside the building are protected by cages. The large electric sign advertising Henkel's flour, which is supported on top of the concrete tower at the river end of the building, contains 600 10-watt lamps. About 250 25-watt lamps are yet to be installed in the old mill.

DATA ON ELECTRICAL OPERATION OF FLOUR MILL

Feeder Circuit	Motor Rating			Drive	Machine Driven		
	Hp	Location, Floor	Full-Load Speed		No.	Kind	Floor
A	300	3	352	1.5-in. wire cable	2	Milling separators	4 & 5
					25	Allis rolls	4
					1	Scourer	4
					2	Prinz dust collectors	4
					1	Automatic weighing machine	3
				(12-groove sheave)	9	Invincible flour packers	3
					1	Grain conveyor	Base.
A	200	4	352	1.5-in. wire cable	3	Invincible magnetic separators	8
					2	Prinz dust collectors	8
				(9-groove sheave)	7	Fraser dividers	8
					11	Fraser bolters	7
					One 36-in.	Double-rotor suction fan	7
					2	Prinz wheat scourers	7
					1	Hock wheat heater	7
					1	Fraser aspirator	7
					3	Prinz dust collectors	7
					14	Fraser purifiers	6
					2	"Little Wonder" reels	6
					1	Prinz four-reel wheat grader	6
					1	Prinz oat grader	6
					2	Fraser aspirators	5
					3	McFeely scrolls	5
					2	Niagara bran dusters	5
					1	Niagara shorts duster	5
					One 36-in.	Double-rotor suction fan	5
					1	Prinz mustard and flax separ.	5
					5	Prinz dust collectors	5
					2	Fraser feeder mixers	5
					63	Burmeister elevators	
B	100	9	436	Belt	..	Elevators	Base. to top of tanks
B	50	2	575	Belt	..	Boat unloader	River end
C	50	Old bldg.	490	Belt	..	Corn mill	Old bldg.
C	50	Old bldg.	490	Belt	1	Grain elevator	Old bldg.
	30			Gear	1	Otis elevator	
D	20	3	865	Belt	4	Allis reels	5
					1	Mustard separator	
					1	Attraction mill	
B	15	Basement	865	Belt	1	Belt conveyor	Under tanks
B	15	5	865	Belt	1	Receiving separator	5
					1	Prinz dust collector	5
F	15	Boiler room	865	Belt	..	Coal and ash handling	Base. to hoppers
C	10			Belt		Pancake flour machinery	Old mill
B	10	Above tanks	865	Back-geared, 7 to 1	1	Belt conveyor	Above tanks
E	Two-10	Outside	860	Back-geared, 7 to 1	2	3-ton car pullers	On siding
D	7.5	7	860	Belt	5	"Little Wonder" bolters	7
E	5			Belt		Grain shovels	Cars
D	3	Basement		Belt	4	Mixers	Base.
D	3	8		Gear		Man elevators	Base. to 8th floor
	2		1130	Belt		Blending feeders	
	125	To be installed later				Rye mill	Base.

NOTE.—Motors grouped on the circuits denoted by letters in Column 1 may be interlocked or simultaneous operation.

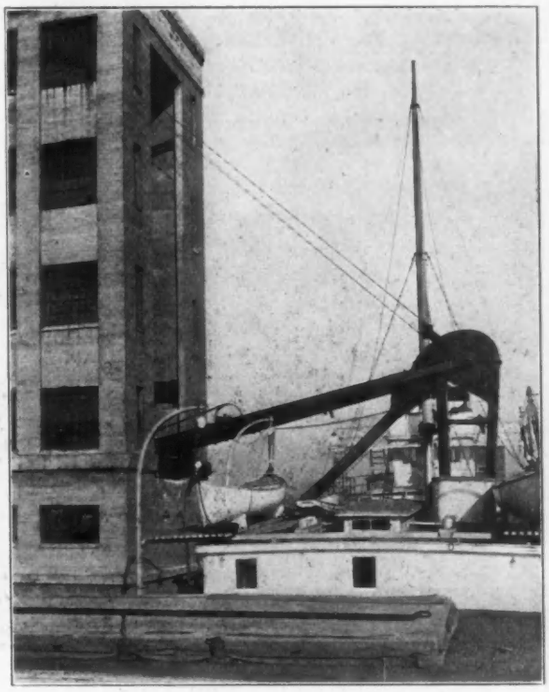


FIG. 11—UNLOADING GRAIN WITH MOTOR DRIVE

A 15-kw, 110-volt direct-current generator directly connected to a Westinghouse gasoline engine which was installed in the old building has been transferred to the new mill to be used as an emergency lighting set.

Data for Five Weeks' Operation

Over a period of five weeks' operation the following data were collected: With a 28-in. vacuum the turbine generated 1 kw-hr. of energy per 17.1 lb. of steam. West Virginia pea, nut and slack coal, costing $2.10 per ton, is used. The usual day load is about 700 amp at 480 volts. An average of 1200 bbl. of flour has been milled and packed with a consumption of 18,450 lb. of coal. The mill operates night and day.

The plant was designed by the Fraser Company, Milwaukee, Wis., the electrical apparatus was supplied by the General Electric Company, and the electrical work was done under the supervision of Mr. William C. Blagden. Mr. F. H. June is chief engineer of the plant. The officers of the Commercial Milling Company are: President, Mr. Robert Henkel; vice-president, Mr. William V. Brace; secretary and treasurer, Mr. F. G. Emmons; superintendent, Mr. John Holtorf.

Effect of Air Leakage on Jet Condensers

Unless special care is taken to remove air which may leak into exhaust mains leading to condensers, the vacuum may be considerably reduced. In a paper presented before the Engineers' Society of Western Pennsylvania, Mr. C. L. W. Trinks pointed out that the vacuum produced by one jet condenser tested dropped from 28.5 in. to 23.2 in. when air weighing 1.4 per cent of the steam entering was admitted. With two other types of condensers only 1 per cent of air by weight reduced the vacuum considerably. Sometimes injection water contains as much as 2 per cent air by volume or 0.125 per cent of the weight of the steam. Air may also leak into the exhaust-steam mains. Mr. Trinks declared that there need be no drop in the vacuum due to the leakage of a small amount of air if the air pumps are designed to remove the correct amount.

Individual Motor Drive in Pen and Pencil Factory

The plant of W. S. Hicks & Sons, 235 Greenwich Street, New York, manufacturers of gold and platinum pens and pencils, has until recently been operated by one large motor, and a complicated system of line and counter shafts was employed. With the shafting many

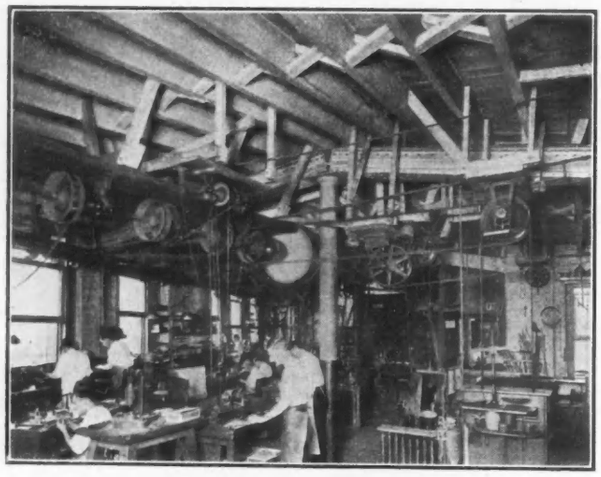


FIG. 1—OLD BELT-DRIVEN SYSTEM

belts had to be used, and the workrooms were necessarily noisy and dusty. In order to eliminate the overhead shafting and belting individual belted-motor drive has been adopted throughout the plant, except in what is known as the pen shop, where a 0.5-hp motor is used for local drive. A number of small high-speed turning lathes are used in this establishment; the motors which operate them are provided with speed-regulating and reversing devices, and foot-treadle switches are used to control the machines. Separate motors are also provided for the draw-benches, furnace blast and polishing machines. The motors for the draw-benches and furnace blast are operated by remote-control push-button switches, placed at points along the machines convenient to the operator. The motors oper-

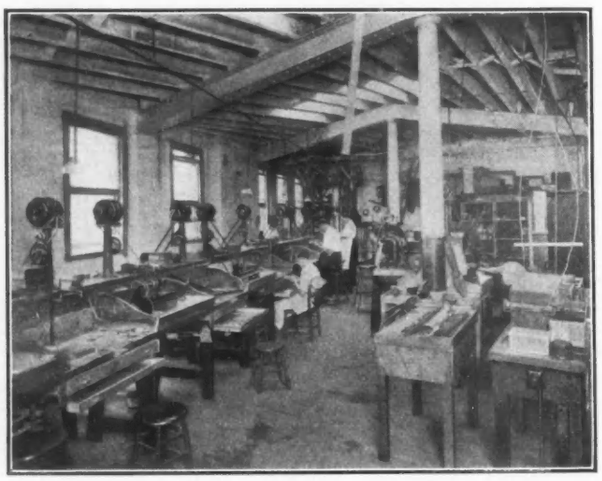


FIG. 2—NEW INDIVIDUAL-MOTOR EQUIPMENT

ate on 220 volts and were made by the Robbins & Myers Company. There are sixteen 0.125-hp motors, two 0.25-hp motors, two 0.5-hp motors, one 1-hp motor and one 7-hp motor. A 2000-watt plating generator is also used in the plant. Figs. 1 and 2 show the plant with the old shaft and belt arrangement and the plant as it appeared after individual motor drive had been installed. The motors were installed by the C. C. Bohn Electric Company, of New York. Energy is obtained from the New York Edison Company.

Steam Versus Electricity in a Corset Factory

A New England central station recently investigated the comparative cost of steam and electrical operation in a corset factory, with the result that the owner was convinced that the motor drive offered sufficient advantage in running expense and convenience of service to warrant early installation. The plant had a friction

TABLE I—COST OF PRESENT STEAM PLANT OPERATION, ONE YEAR

Coal	$1,800.00
Labor	1,000.00
Gas and maintenance	522.00
Water	105.00
Interest on boiler plant at 5 per cent	75.00
Depreciation on boiler plant at 10 per cent	150.00
Electric lighting	80.00
Repairs and supplies	90.00
Total (steam)	$3,822.00

load of 37.2 hp, the average load on the 100-hp engine in service being only 40.1 hp. This excessive loss in transmission, combined with a poor engine load-factor, made the demonstration of superior economy by the use of central-station service comparatively easy.

With the proposed electric drive twenty-two three-phase, 440-volt induction motors aggregating 49 hp are required, the range of the motors being from 2 hp to 6 hp. In the new layout a 2-hp motor is provided for each sewing machine table, there being twenty machines per table; two 6-hp motors are called for in connection with the elevator service, and three tape winders are provided with a 1-hp motor in each case. A 3-hp motor is to drive a cutter and a 1-hp motor will operate a grindstone. The power layout provides for placing the motors under the tables with a silent-chain drive to the machine countershaft, the chains and sprockets being inclosed to avoid accidents and greasing the material handled by the employees. Switches are to be placed either under the tables or on the walls and inclosed in fireproof boxes to guard against contact. The installation of sixteen 650-watt electric irons in place of an equal number of gas irons was figured in the operating cost, supplying the irons on the power rate. The necessary lighting installation was found to

TABLE II—ESTIMATED COST OF ELECTRICAL OPERATION

Coal for heating, 135 tons at $4.85	$654.75
Labor, 200 days at $2	400.00
Water	25.00
Interest on boiler plant, 5 per cent	75.00
Depreciation on boiler plant, 5 per cent (steam heating)	75.00
Repairs	10.00
Supplies	10.00
Interest and depreciation, electrical equipment, 10 per cent	280.00
Central-station energy, total input, 4415 kw-hr. per month	1,574.04
Total (electric)	$3,103.79

total 7 kw connected load, the usual unit being a 100-watt lamp equipped with an enameled-steel reflector and placed directly over the machine.

The installation cost of the motor-driven service was found to be $2,800, including wiring for motors, lamps and irons, a lighting transformer of about 7½-kw rating, twenty-two motors, silent chains and housings, lamps, irons and all machine work necessary to equip the elevators and other apparatus in the plant. From the tables herewith it will be seen that the net estimated saving in operation by electricity is $718.21 a year, or 25.7 per cent on cost of installing central-station service.

Operating Cost Analysis in an Underwear Factory

In a study of energy costs recently made in an underwear factory in New England the engineers of the local central station found that with mechanical drive about 60 hp was required to run the installation. The estimated yearly operating costs of the plant as a whole, on the steam-engine basis and with electric motors, are given in the tables. They show a saving in operating cost by electricity of $546.60.

TABLE I—PRESENT COST OF STEAM POWER OPERATION

Coal, 250 tons at $5	$2,250.00
Labor in plant	1,040.00
Water	64.80
Oil, waste, etc	45.00
Repairs	50.00
Removal of ashes	28.00
Total	$3,477.80

The survey showed that with electric drive an average load of only 31.6 hp, with a maximum of 42 hp, would be required, including an allowance for energy used in lighting and in the operation of an elevator pump and deducting the power lost in shafting, hangers and belts. The cost of the electrical installation, including individual motor drive, was estimated at about $3,000, so that, even allowing 10 or 12 per cent for depreciation, insurance and taxes, there would still be a saving in the electrical service of this factory.

The power report advocated the use of motors under the machine tables, with silent chain drives guarded from contact by employees, and pointed out that the

TABLE II—ESTIMATED COST OF ELECTRICAL OPERATION

Coal, heating only, 150 tons at $5	$750.00
Water	10.00
Supplies	10.00
Repairs	20.00
Fireman	468.00
Electrical energy purchased	1,663.20
Removal of ashes	10.00
Total	$2,931.20

adoption of electric service would not only assist in the better routing of the material and insure great cleanliness in departments at present subjected to stock damage from lint, dust and oil thrown by belts, but would get rid of five countershafts, sixty-five hangers and thirty-nine belts.

Electric Motors in the Portland Cement Industry

Data on a local cement mill recorded under the direction of Mr. Gordon Weaver, "power-sales" manager of the Kansas City (Mo.) Electric Light Company, over a period of one year and four months, show that in this plant an average of 20.05 kw-hr. of energy is used to manufacture a barrel of cement. The number of kilowatt-hours used per month per horse-power connected was for the same period 309. The rating of the plant is 2000 bbl. of cement a day, and the average daily plant output during the year ended Aug. 1, 1914, was 1924 bbl., thus showing that the plant after reaching its stride had operated near its full rating at all times. One hundred and sixty men are employed at the cement factory, which operates twenty-four hours a day and 365 days a year. Exclusive of the lighting the connected load at the mill is 3668 hp and the maximum demand is 2500 kw. The load-factor on a 720-hour-a-month basis is 65 per cent. All of the motors are of the Wagner induction three-phase, twenty-five-cycle, 440-volt type, and an effort has been made to obtain interchangeability by purchasing as nearly as possible all motors of the same speed, 750 r.p.m. Most of the large motors are started on reduced voltage. Electrical energy is delivered from the central station to the cement plant over a double transmission line operating at 33,000 volts and terminating in a bank of three single-phase, 750-kva transformers.

TABLE I—DATA ON ENERGY USED AND CEMENT PRODUCED

Month	Kw-hr., Total	Kw-hr. Main Mill	Kw-hr. Coal Mill	Bbls. Cement	Main Mill; Kw-hr. per Bbl.	Kw-hr. per hp Connected	Kw-hr. per Bbl., Total
1913:							
April	801,400	692,680	103,720	41,534	16.67	218	19.29
May	1,093,400	954,920	133,480	55,615	17.17	298	19.66
June	1,104,000	974,160	129,840	50,272	19.37	300	21.95
July	1,111,000	970,360	140,640	55,047	17.60	302	20.18
August	1,186,000	1,024,960	161,040	64,050	16.00	323	16.95
September	1,014,000	870,240	143,760	57,049	15.25	276	17.77
October	1,041,000	890,520	150,480	53,168	16.74	284	19.57
November	1,119,000	975,240	143,760	53,336	18.32	305	20.98
December	1,115,000	1,079,880	135,120	50,010	21.59	304	22.29
1914:							
January	1,164,000	1,027,680	136,320	53,020	19.38	317	21.95
February	955,000	832,120	122,880	45,366	18.34	261	21.05
March	1,233,000	1,086,120	146,880	57,824	18.78	332	21.32
April	1,260,000	1,023,200	136,800	60,827	18.46	343	20.71
May	1,318,000	1,175,920	142,080	67,055	17.53	359	19.65
June	1,278,000	1,133,280	144,720	68,092	16.64	349	18.76
July	1,318,000	1,159,360	156,720	69,538	16.67	359	18.95
Total	18,110,800	16,870,640	2,233,240	901,803	284.51	4930	321.03
Average	1,129,000	1,051,000	139,300	56,250	17.77	308	20.05

When the former steam installation at the mill was abandoned for electric drive, Griffin mills were discarded and tube mills and "slypeb" mills were installed. Other new equipment was also added. Of the old steam

TABLE II—MOTOR APPLICATIONS

No.	Hp	R.p.m.	Application
5	100	750	Raw tube mill.
4	100	750	Finish tube mill.
3	150	750	Raw comminutor mill.
3	150	750	Finish comminutor mill.
2	100	750	"Sylpeb" mill.
1	100	750	Rock crusher (7.5 Austin).
1	100	750	Spare motor.
1	75	750	Blower.
1	50	750	Hoist.
1	50	750	Spare.
2	40	750	Rock drier.
4	30	375	Kiln; variable speed motors.
2	30	750	Clinker cooler.
1	30	750	Tube mill elevator and conveyor (raw).
1	30	750	Drier, blower.
1	30	750	Comminutor elevator and conveyor (raw).
1	30	750	Tube mill elevator and conveyor (finish).
1	30	750	Screw conveyor (stock house).
1	20	750	Gypsum and coal belt conveyor.
1	20	750	Coal crusher.
1	20	750	Main rock belt and elevator.
1	20	750	Spare.
1	20	750	Packing-house conveyor (belt).
1	20	750	Rock elevator.
1	15	750	"Sylpeb" elevator.
1	15	750	Clinker belt (finish).
1	15	750	Rock, pan conveyor.
1	10	750	Pump motor.
1	10	750	Shovel (geared).
1	10	750	Shovel.
1	10	750	Machine shop.
1	5	1500	Winder, electric repair shop.
1	5	1500	Quarry, blacksmith shop.
1	5	750	Clinker elevator.
1	5	750	Sack shaker.
1	5	750	Spare.
1	3	1500	Single phase; labcratory.
1	150	750	New rock crusher.
1	350	375	Synchronous; direct to Sullivan 1500-ft. compressor.
*1	450	300	Westinghouse; belted to Sullivan 1500-ft. compressor.
1	200	750	Commimutor coal mill.
1	35	750	Elevator, coal mill.
1	10	750	Conveyor, coal mill.
1	5	750	Conveyor, coal mill.

* Installed since July 1. Consumption not included in data.

installation one 300-hp Oil City boiler was retained, and it is now used for heating the office in winter and for supplying steam to atomize oil burned under two driers in the plant. Coal is burned in four kilns.

Operating Kinks

Locking Steam Valves to Prevent Accidents

To protect its employees from being scalded by steam while working in boilers or repairing prime movers, the Edison Electric Illuminating Company of Brooklyn, N. Y., has established the practice of locking steam

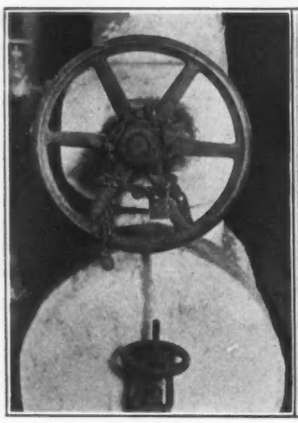


FIG. 1—STEAM-HEADER VALVE LOCKED

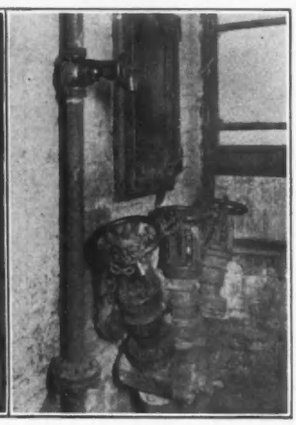


FIG. 2 — BLOW-OFF AND FEEDER VALVES LOCKED

blow-offs, drain and feeder valves with a padlock and chain, as shown in the accompanying illustration. By doing this and requiring all employees to get permission from the engineer on watch before opening any valves accidents have been prevented which might otherwise have occurred. In locking a valve a chain is wound around the rim and spoke of the hand wheel and locked to the yoke. All of the padlocks can be opened by one key which is kept by a man who is fully acquainted with any repair work that may be going on in the station.

It has been found to be especially desirable to lock valves in pipes leading to prime movers which are being repaired or in boiler headers to prevent any accidental opening of valves and thus allow steam to leak into a unit which is being repaired or is having the boiler scale removed or the grate bars renewed.

Boilers Permanently Equipped with Soot Blowers

All boilers in the 201st Street Station of the United Electric Light & Power Company, New York City, are equipped with soot blowers so that deposits on the water tubes can be removed every twenty-four hours. The blower equipment of each boiler consists of seven horizontal pipes equally spaced above the upper row of water tubes. Each of these pipes is equipped with twenty-one nozzles which are inclined so that they will blow diagonally through the nest of tubes. The nozzle headers are connected with a common supply header above the boiler by vertical pipes. As the soot blowers are exposed to intense heat they had to be protected from melting by allowing air to circulate through the supply pipes and nozzles during the normal operation of the boiler. As a partial vacuum is maintained over the grates anyway, it was possible to obtain the desired air circulation by installing a ball valve in the supply pipe leading to the nozzles. This valve allows cool air to be drawn into the blower pipe by the vacuum in the furnace but does not allow a reverse current when compressed air is supplied to the nozzle for removing soot from the tubes.

Drying Wipers by Generating Room Exhaust

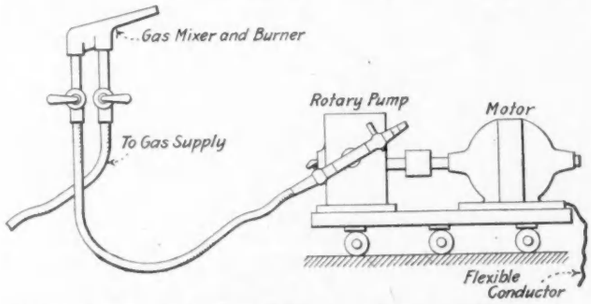
At the hydroelectric generating plant of the Rumford Falls (Maine) Power Company wiping cloths used instead of waste in cleaning machinery are dried after

DRYING WIPERS BY ENGINE-ROOM EXHAUST

being put through an electric washing outfit by exposing them to warm air discharged from the operating room, as shown in the accompanying photograph. To the discharge duct leading above the roof is attached a home-made lateral galvanized-iron box 4 ft. high, 2 ft. 7 in. deep and 3 ft. 10 in. wide, with eighteen louvers 5½ in. wide each, hung on wires terminating in bent ends on the sides of the chamber. The cloths are pinned to a line fastened to a ¾-in. pipe frame carried outward in front of the louvers, and a small fan motor in the further side of the chamber forces air through the louvers and facilitates rapid drying. The louvers are of the swinging type to prevent back drafts and the entrance of rain or snow, in case the motor is not in use. Cloths have been used eighteen times by utilizing this outfit, a combination of the electric washer and of cleaning powder having done away entirely with the use of waste. The plant is heated electrically throughout.

Portable Equipment for Soldering

When it is impossible to employ gasoline blow torches in heating metal which has to be soldered a small motor



PORTABLE AIR COMPRESSOR FOR SOLDERING TORCH

may be used to drive a rotary pump delivering air to a blow-pipe burner. So that the equipment may be portable the pump and motor should be mounted on a common base provided with casters. To avoid aligning

the shafts of the units they can be connected with flexible or universal couplings. Energy can be supplied to the motor through flexible conductors. The method of connecting the equipment is represented in the accompanying drawing.

Wiring Safeguards in Sterling (Ill.) Station

To make it impossible for an operator in the hydroelectric station of the Illinois Northern Utilities Company at Sterling, Ill., to close oil switches on the 2300-volt switchboard without first knowing that the apparatus he is connecting is in synchronism, the 125-volt circuits actuating the switches are connected through the synchronizing sockets. If the synchronizing plug is not in place, the oil-switch control circuit is open, and therefore an operator's first action when he wants to throw a switch must be to put the synchronizing plug in the socket provided for it. While this action makes the oil switch operative, it also connects the synchroscope and lamps in the circuit and calls attention to the fact that synchronism either does or does not exist.

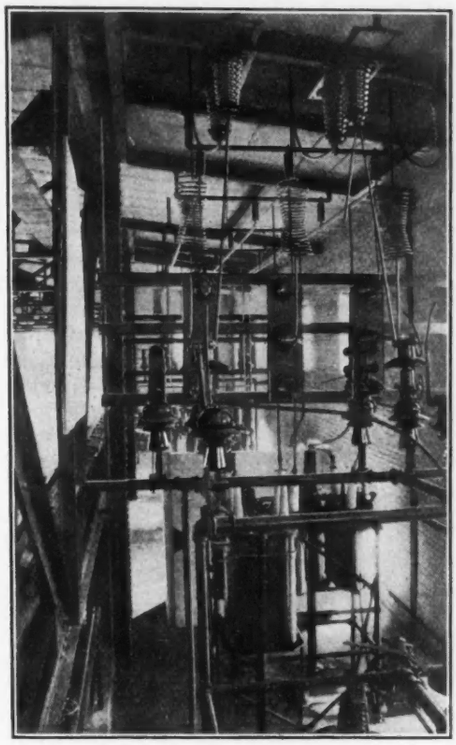


FIG. 1—33,000-VOLT APPARATUS AT STERLING STATION

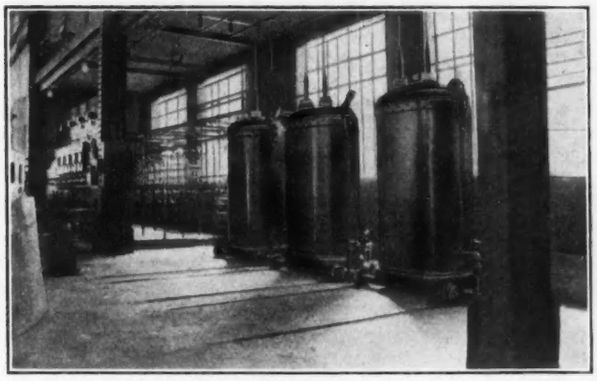


FIG. 2—TRANSFORMERS AND MAIN SWITCHBOARD

The 2300-volt board in this station is also equipped with a relay bus arranged near the top of the switchboard framework. Disconnecting switches mounted in neat alignment beneath this bus may be thrown upward to make connections through the relay bus and thus deenergize the oil switches, instrument transformers and wiring, so that men may work on any apparatus near the lower part of the board without fear of receiving a shock.

As a part of the 33,000-volt equipment, the larger disconnect switches have been arranged with back positions so that energy may leave the station without passing through the high-tension oil switches. The latter units, therefore, may be inspected or repaired without danger at any time. The illustrations herewith show the 750-kva transformers and 2300-volt board on the first floor and the high-tension equipment in one of the upper galleries of the station.

Old Condenser Serves New Turbine with Increased Rating

When a 5000-kw vertical turbine in the power house of the Metropolitan Street Railway Company, Kansas City, Mo., was recently replaced by a 10,000-kva, 6600-volt, twenty-five-cycle, three-phase horizontal turbo-generator the condenser which had served the old machine was used with the new unit. The condenser is a three-pass unit with 20,000 sq. ft. of cooling surface, and it is estimated that it can easily maintain sufficient vacuum, since the steam guarantee on the old machine was 21 lb. per kw-hr. and the guarantee on the new machine is about 14 lb. per kw-hr.

Heating of Water Tanks in Winter

In the operation of a small power plant it frequently happened that an insufficient supply of steam was delivered to the various points at which this was to be used. This was due to a minor though vital method of operation.

It was the practice of the engineer on extremely cold days to open the valve on a 1¼-in. high-pressure steam line which discharged into an exposed water tank. This was done in order to prevent freezing of the tank water. The amount of steam that can be supplied by a 1¼-in. line blowing directly into a body of water is enormous, and it was sufficient in this case to cripple the service at other points. As the service was already overburdened and subject to varying demands, it was only after repeated occurrences that the difficulty was traced to its source.

The supply of steam to the tank could have been limited by the throttling of the supply valve, but this would have meant more or less supervision with the possibility of the water freezing in the meantime.

A better method for such a condition is to install a ¼-in. or ½-in. steam line connected to such a tank and arranged to deliver steam continuously from the start of winter, by which means the temperature of the water may be maintained at such a point that sudden demands for steam on the colder days would be unnecessary. In other words, it is better to supply steam continuously to a tank in small quantities than to attempt to supply a large amount in a short period, unless the capacity of the station is arranged for such emergencies, which is usually not advisable. In the latter event the tank should have a direct connection from the tank to the steam header in the boiler room, and not be connected to piping that is used for other purposes.

Extracts and Abstracts

Preventing Bursting of Flywheels

Statistics show that the percentage of flywheels which burst is larger than the percentage of boilers which explode. It appears, therefore, that conditions causing the bursting of flywheels should be as carefully studied and prevented as those producing boiler explosions. According to the monthly bulletin of the Fidelity & Casualty Company of New York, flywheels in themselves have not been found to be defective very often but some accident to or disarrangement of the speed-governing mechanism allows the engine to race and thereby burst the flywheel. By giving attention to governing apparatus accidents may therefore be prevented.

Peat as a Source of Power

In a paper on "Sources of Power" read at the Lenox (Mass.) convention of the National Association of Cotton Manufacturers, Mr. F. W. Dean, consulting engineer, Boston, Mass., commented upon the value of peat as a fuel in power development. Peat is widely deposited, occurring in shallow, wet depressions. It is estimated that there are 13,000,000,000 tons of it in the United States, exclusive of Alaska, and that its potential value is about $3 per ton. Peat is always wet and contains from 85 to 95 per cent of water, necessitating aid-drying before use. If exposed to the atmosphere, water is immediately re-absorbed. Atmospheric drying for a few days reduces its weight 50 per cent, and continued drying in sun and wind will reduce its weight from 8 to 25 per cent. It must be compressed for use commercially, as air-dried peat requires from eight to eighteen times the space of good coal and when fired in boilers calls for almost continuous shoveling. The heating value varies from 5200 to 9300 lb.-Fahr. heat units per lb., surpassing wood and lignites. Peat burns with a clear flame, forming a hot, responsive fire, a small amount of ash and no clinkers. Producer gas from peat contains from 132 to 175 lb.-Fahr. heat units per cu. ft., compared with 144 to 156 from coal.

Prevention of Boiler Scale and Corrosion

The prevention of boiler scale and corrosion does not depend so much upon the compound employed apparently as on the method of using it. At a meeting of the American Society of Mechanical Engineers held recently in San Francisco Mr. A. H. Babcock described the method used for preventing boiler-tube trouble in the Fruitvale (Cal.) power plant of the Southern Pacific Company. The compound employed consisted of anhydrous sodium carbonate, 76 per cent; tri-sodium phosphate, 10 per cent; starch, 1 per cent; tannic acid, 2 per cent, and water, 10 per cent. The constituents were dissolved in hot water and added to the boiler-feed water in such quantities as always to maintain a concentration of 3 per cent normal alkaline strength. In order to maintain a uniform concentration it was necessary to treat each boiler individually, as it was found unsatisfactory to add a certain number of pounds of the compound per pound of coal burned or per gallon of feed water supplied to the boilers. Instead, a chemical analysis of each boiler's content was made before predetermining the amount of compound to be added. The water had to be tested every day in order to make up for any deficiency in alkalinity, as some compound was removed when the boilers were blown off and some was lost by combination with impurities in the feed water. In practice the percentage of alkalinity of the water was determined by multiplying by 0.002 the number of cubic centimeters of one-tenth normal sulphuric acid required to neutralize 50 cu. cm of the boiler water. Methyl orange and phenolphtalein were used as indicators.

The effectiveness of this boiler compound is shown by the following figures. Before boiler-water treatment was employed tubes were being replaced at the rate of 1400 a year, while in the three months following the use of the compound tube replacement was rapidly decreased to zero. The treatment costs less than $100 a month as compared with $10,000 a year, the former expense of replacing tubes.

Besides preventing pitting due to the presence of sodium carbonate, the compound also prevents the formation of scale as solid particles are kept in suspension until the boilers are blown off. All salts are precipitated in colloidal form as the tannic acid prevents crystallization. Priming is minimized by the tri-sodium phosphate. When the compound is first used it loosens the rust and may start leaks. To remove solid matter the boiler should be washed frequently.

At the Fruitvale plant it is usually necessary to add from 4 lb. to 20 lb. of compound to each boiler during a watch. For treating the water employed in the locomotives operated by the Southern Pacific Company it has been customary to add 3 lb. of compound per 1000 gal. of feed water. In some localities it may not be possible to maintain a concentration of 3 per cent because of priming, in which case corrosions may be considerably retarded with boiler water averaging as low as 0.5 per cent alkalinity.

A. S. M. E. Boiler Report Receives Considerable Attention

The importance of the problem that has arisen in the formulation of the Boiler Code was emphasized by the attention that was given to the report of the boiler specifications committee of the American Society of Mechanical Engineers at its recent annual meeting. Six separate sessions having an aggregate duration of twenty hours were devoted exclusively to the discussion of the Boiler Code and the work of the committee.

At the first session Mr. John A. Stevens, chairman of the Boston specification committee, called attention to the need for a boiler code, outlined the progress of the committee considering this code, and explained how provisions have been made for receiving further suggestions or criticisms of the report. During the discussion which followed a number raised objections to the method of procedure employed by the committee, and others expressed themselves against including legislative requirements in the code, saying that it should concentrate upon technical rulings and engineering features only. The majority of those attending the meeting, however, favored the general plan and commended the committee for its work.

The safety-valve requirements which had been approved at a conference of safety-valve manufacturers and the boiler committee, and had been considered an important advance in this direction, were not well received by practical men. Those who had had actual experience in inspecting boilers criticised the requirements on the ground that they were too complicated and cumbersome for convenient use and also because the method of basing the steam-producing ability on the heating value of the coal would in certain cases require a larger safety valve to be applied if boilers were moved to states where different fuels would be employed. As the criticism on the modified requirements

of this section was so strong, it was decided to refer the entire problem back to the safety-valve conference at which the requirements were proposed.

Owing to a diversified opinion on the welding of shell joints, this section of the report was slightly modified. The materials specifications in their present form are acceptable to the society, but where they differ slightly from those of the American Society for Testing Materials it is probable that the specifications of the latter will be made to agree with those of the American Society of Mechanical Engineers. Amplification of specifications to cover iron rivets, staybolt steel, bar iron and bar steel was referred to the committee representatives of steel manufacturers with instructions to select specifications from the standards of the American Society for Testing Materials to cover the requirements. The new tube specification which was the result of the first complete conference of boiler-tube manufacturers of America was favorably commented upon.

The quality of steel for various parts of boilers was considered more thoroughly than it has ever been before, with the result that the section relating to it was completely modified and settled to the satisfaction of all In general, the ruling now stands that furnaces, shells, combustion chambers, or any part of boilers under pressure and exposed to the products of combustion, have to be made of firebox-grade steel. It was suggested that the specifications for heating boilers be separated from those for power boilers so that the particular requirements of each class of boilers can be adequately treated. This matter was referred to a representative committee of heating-boiler manufacturers for further study. Various requirements unintentionally limiting the size of boilers or enforcing unnecessary hardships on manufacturers received careful attention at this time. The clause limiting the length of longitudinal joints was stricken out and that referring to the process of forming butt-straps radically modified.

Questions of factor of safety and age limit were referred to a committee consisting of Profs. A. M. Greene, Jr., and William Kent and Messrs. Frederick Sargent, F. H. Clark, Thomas E. Durban and H. G. Stott. A motion was made and carried that a new set of tables on the efficiencies of riveted joints be prepared, using a tensile strength of 55,000 lb. only and the new revised shearing-strength values for rivets. A motion was also made that the code be re-drafted so as to eliminate all legislative requirements and to include technical rulings and engineering features only.

Factor of Safety for Boilers

For high-pressure boilers a factor of safety of five is none too high. During service they are subjected to intermittent stresses due to expansion and contraction caused by alternate heating and cooling. Varying stresses are also set up by a "breathing action" caused by the irregular rate at which steam is supplied to reciprocating engines. The Fidelity & Casualty Company of New York advises increasing the factor of safety with length of service as intermittent stresses gradually fatigue metal. The factor includes a true factor of safety and also a factor of ignorance. The latter allows for non-uniformity of strength in material, deterioration resulting from abuse during construction, and varying qualities of workmanship. The true factor of safety takes into consideration changes in load and the yield point of the material. If the factor is based on the ultimate strength of the material, the actual margin of safety is considerably lower than it would be if the yield point or elastic limit were considered as the basis for estimating.

Questions and Answers

Ball Bearings for Meters

Is there any relatively inexpensive, reliable and frictionless substitute for diamond bearings in meters? P. M. A.

One of the large central-station companies is equipping all of its direct-current meters with ball bearings. These have been found practically equivalent to steel points bearing on diamond cups so far as friction is concerned. Ball bearings last practically indefinitely, and are less expensive than diamonds.

"Phasing Out" Transformers

Frequently we are required to interconnect different designs of single-phase transformer to furnish three-phase service. Please describe a simple method of determining their relative polarities. A. G. K.

In a single-phase transformer the high-tension and low-tension voltages must be either in phase or in opposition, therefore it is a simple matter to determine the relative polarity of the terminals. Assuming that *A* and *B* are the high-voltage terminals and *C* and *D* the low-tension taps, connect *B* and *C* and apply a low voltage to *A* and *B*. If the voltage across *AD* is greater than that applied to *AB*, the primary and secondary pressures act additively. If the pressure across *AD* is less than that across *AB*, the primary and secondary voltages are opposed to each other. All transformers giving the increased voltage reading with this test may have their corresponding terminals marked with opposite signs. If the over-all voltage is less than that applied, corresponding terminals may be marked with similar signs. These signs will indicate how the transformers should be connected. For instance, if the primaries are to be connected in Y, all primary terminals of one sign are connected together and those marked oppositely connected to the three supply wires. Similarly if the secondaries are to be connected in delta, the positive terminal on each transformer should be connected to the negative tap on the next.

Rate of Water Flow to Cool Transformers

What is the most economical rate at which water should be circulated through transformer cooling coils? H. G. P.

Water of ordinary temperature should be circulated through transformer cooling coils at the rate of 0.25 gal. per minute per kilowatt loss. As 1 kw will raise the temperature of 3.8 gal. of water 1 deg. C. in one minute, the temperature difference between water inlet and outlet should be about 15 deg. C., provided that the separating medium is a good conductor. Increasing the rate of flow will decrease the temperature rise of water in inverse ratio, while the temperature of the windings is lowered approximately one-half the amount by which the temperature of the water is lowered. On the other hand, decreasing the water rate increases the temperature rise in inverse proportion and the temperature of the windings is raised about one-half the amount that the water temperature is increased. For example, if the rate is increased from 0.25 gal. to 0.375 gal. per minute per kilowatt loss, the difference between water inlet and outlet temperatures will be reduced from 15 deg. C. to 10 deg. C., making the average temperature of the water 2.5 deg. lower for the higher rate, and the winding temperature will be correspondingly lower. Therefore it can be seen that no great gain is made by increasing the water rate. If, however, a heavy overload is placed on the transformer, it will be advisable to

increase the rate of flow. The initial temperature of the water will, of course, have to be taken into consideration.

Simultaneous Operation of Three-Wire Generators and Balancer Sets

Can balancer sets and three-wire generators be operated on the same system? O. B. H.

Balancer sets and three-wire generators cannot be operated on the same system at the same time as the compensator used with the latter will make a short-circuit across the balancer set. If both types of machines must be operated together, the neutral of the compensator must be disconnected and all load unbalancing taken care of by the balancer sets. The latter will allow shifting of the neutral while three-wire generators will not.

Advantages of Turbine-Driven Centrifugal Boiler-Feed Pumps

What advantages are possessed by centrifugal boiler-feed water pumps which make their installation so common nowadays? W. S. C.

Centrifugal pumps operate with very little attention, have a minimum of maintenance charge, and rating for rating occupy much less space than a reciprocating pump. Automatic control, while desirable, is not necessary, because if the pump be left running with all of the boiler-feed valves shut tight it merely churns up the water in its casing without injury. Being a rotary pump and operating at high speeds, it is especially suitable for connection to steam turbines or electric motors. Usually steam turbines are employed in preference to electric motors because the condensate from the turbine can be used for heating the feed water. Besides, the condensate does not contain contaminations in the shape of oil.

Division of Load Between Engines

In a certain generating station containing a 75-kw, sixty-cycle, three-phase unit driven by a Corliss engine and a 150-kw, sixty-cycle, three-phase unit driven by a high-speed reciprocating engine, it has been found that, although the units can be synchronized, they will not operate properly together. When the load increases the equilibrium is upset and the Corliss unit comes almost to a standstill, and the attendant must open the circuit to prevent the cross-current between the units from blowing the fuses. What can be done to cause the units to operate satisfactorily in parallel? D. F. F.

Doubtless the trouble encountered in operating the generators in parallel has been caused by the lack of similarity of the load-speed characteristics of the two engines. In order for the two generators to divide the load in proportion to their rated output, the two engine governors must be so adjusted that under load conditions the drop in the speed of the one acting alone is identical with the drop in speed of the other acting alone carrying the same percentage of its full load as the other engine. Unless there is an appreciable drop in speed under load, the division of load between the units in parallel will be unstable. Moreover, if the impulses of the engine occur at time periods corresponding to the vibratory periods of the two generators when connected together electrically, then the units will "hunt." That is, first one and then the other will take the load with an accompanying interchange of large cross-currents between the generators, until finally the two units will be thrown out of step and the currents will increase to the short-circuit values. By equipping the governors with dash-pots and adjusting them to give equal "dropping" load-speed characteristics the trouble can probably be overcome, provided that the resistance of the interconnecting circuits is sufficiently low. Steam turbo-generator units and reciprocating-engine units of either the low-speed or the high-speed type can be operated in parallel provided that proper adjustment is made in the load-speed characteristics.

Analysis of Cable Faults

Please describe how conditions in faulty cables may be determined and how fault resistance may be reduced prior to locating the defects. N. E. L.

For the analysis of cable faults prior to their actual location the following equipment may be employed: Some form of bridge capable of measuring 0.1 ohm to 300 ohms, a sensitive voltmeter having a resistance of 200 ohms to 500 ohms per volt, and a direct-current source and a 32-cp lamp of the same voltage. It is advisable to provide at each cable terminal short flexible conductors for connecting feeders or grounding them. If three-conductor cables are used extensively the connectors may consist of three conductors joined to a common lead for grounding and equipped with clips for clamping to the cable conductors. The preliminary experiments consist of testing for continuity, crosses and ground. The cable conductors should be tagged and numbered and a chart made on which results of the test can be noted. In cables containing more than one conductor ruptures are usually accompanied by crosses and ground. With both ends of the faulty cable clear and other than test connections removed the far end of a conductor and one side of the energy supply should be grounded and the other side connected with the near end of the conductor through the lamp to see if it burns with the usual intensity. If there is any doubt, the bridge should be employed to measure the conductor resistance, which should be compared with the value as computed from the length and size of the cable. In this test the return circuit should be completed through a good conductor to determine the resistance of the "open" if there is one. Each conductor should then be tested separately for insulation resistance by the well-known series method employing the voltmeter. If any conductor shows low resistance to ground the insulation should then be measured with a bridge. Conductors having a similar insulation resistance should be tested in pairs for crosses by grounding one conductor and seeing whether the insulation resistance is considerably diminished. This should be done first by the series method, then with the bridge. If the tests indicate that any of the faults have more than 100 ohms resistance, it should be reduced before proceeding with the tests. The apparatus necessary for breaking down faults depends largely on the size of the system. If high voltage is required, the apparatus should be capable of carrying the charging current. It is not necessary to form a metallic connection at the fault, nor is it often possible. The object should be to carbonize the paper insulation at faults so that localizing tests can be conducted. It is best to assume the paper wet or damp and to dry it with 3 amp to 5 amp for about ten minutes before carbonizing. Dry paper will carbonize in from five to ten minutes with 1 amp flowing, giving a path of 10 ohms resistance, which is practically stable for test currents of a few amperes. In any case a current-limiting device should be inserted in the circuit to prevent a surge. When special apparatus has to be provided for break-down the most satisfactory results will usually be obtained with a single-phase transformer supplied from a low-tension system through a water rheostat. Whatever scheme is followed, ammeters, voltmeters and wattmeters should be employed for following fault conditions and a direct-current voltmeter should be connected in series with the conductor for quickly checking the fault resistance at frequent intervals.

COMMERCIAL SECTION

New York Appliance Salesroom Attracted Many Christmas Shoppers

Crowds of Christmas shoppers visited the appliance salesroom of the United Electric Light & Power Company, New York City, during the first three weeks in December. While the purpose of the appliance-sales department is primarily to increase the load on the com-

THE UNITED ELECTRIC LIGHT & POWER CO.
Make this an Electrical Xmas
GIVE USEFUL GIFTS
Showroom
138 Hamilton Place
Amsterdam Ave. & 143rd St

FIG. 1—ILLUMINATED SIGN URGING ELECTRICAL GIFTS

pany's own lines, it is reported that over 30 per cent of the articles sold during the last holiday season were sent to other parts of the country. Sales ran especially high on portable lamps and were also large on irons, toasters, percolators and chafing dishes. The attention of the public was attracted to the company's display of electrical devices by the window displays and the illuminated signboard shown herewith, by appropriately decorated signs on delivery wagons, and by holly-decorated mailing folders representing Santa Claus pointing to a number of devices suitable for Christmas gifts. Across the top of the folder were printed the words "'I'll stand by any United Electric gift!' says wise old Santa." For the convenience of persons who were unable to call at the salesroom the company offered to send appliance demonstrators on request. Also printed on the folder were the words "The gift electrical, the kind that always has a use."

All articles sold during the holiday season were wrapped in holly-decorated tissue and wrapping paper, bound with green tinsel cord and sealed with Christmas stickers. Each purchaser was also provided with a Christmas card on which his name was artistically inscribed by an expert penman engaged by the company.

The display windows were too shallow for elaborate decorations, so the one on the left in the accompanying illustration was ingeniously extended as follows: At the front of the window was erected a wide flat-topped frame arch, from which shirred bands of red and green cloth were stretched to a very small frame several feet back of the window to form an appropriate

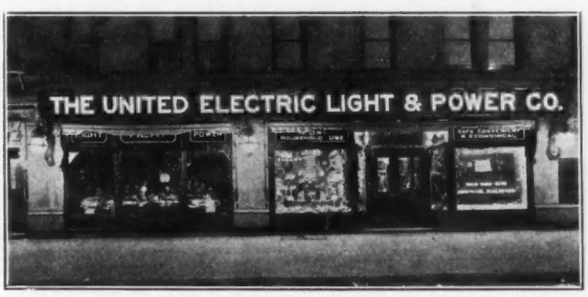


FIG. 2—DISPLAY WINDOWS OF APPLIANCE SALESROOM

ceiling and background. At the apex of the cone thus formed was placed a tungsten lamp concealed by a translucent disk bearing the company's seal. This source furnished enough light to illuminate household appliances and small portable lamps displayed in the window. The electrical devices were set on steps draped with Christmas colors and cotton flannel sprinkled with artificial snow. The tapered ceiling had the effect of making the window look considerably deeper than it actually was. In the foreground were placed a number of well-worded signs such as "Gifts that please," "Make a sensible gift this Christmas," etc. A small image of Santa Claus was placed in a holly wreath in the center of the foreground.

The two remaining windows had no backgrounds so that the passers-by might be attracted by the interior decorations as well as the articles displayed in the windows. A miniature electric locomotive and train was kept in operation in one of the windows to attract children's attention. In the window was also a miniature lamp-letter sign worded "This Christmas give something electrical." Inside the salesroom where it could be seen from the street was a large evergreen tree decorated with electrical ornaments. Other interior decorations and methods of displaying stock are shown in the third illustration.

As this display room occupies space in an apartment-

FIG. 3—INTERIOR OF SALESROOM DECORATED FOR HOLIDAYS

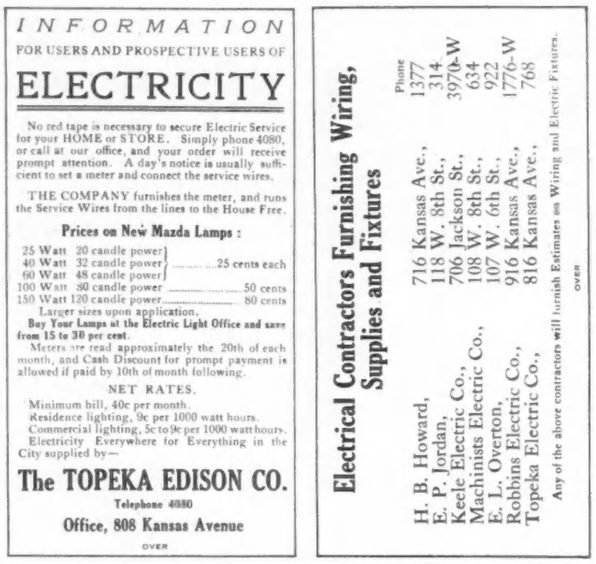
house building in the residence portion of the city and was never wired for extensive electrical decoration, the results which were obtained should be of interest to dealers similarly handicapped.

How 700 Houses Were Wired in One Year at Topeka, Kan.

Without employing a single new-business solicitor the Topeka (Kan.) Edison Company has made a net gain of 700 wired houses during the last year. By the use of posters, street-car and newspaper advertising, persistent circularization of a well-kept list of 5000 prospective customers and the able aid of seven electrical contractors, the company's service and the 40-cent minimum bill were kept constantly before the public. To show absolute fairness and to aid the contractors in every way the electric-service company keeps an information card handy at all times to answer the often-repeated question, "Who can do a good job of wiring for me?" This card, both sides of which are reproduced herewith, on one side tells something of the company's service, the prevailing prices of lamps and the net rates. On the opposite side it carries the names of the seven electrical contractors co-operating with the company, together

with their addresses and telephone numbers. These cards may also be used as envelope stiffeners.

Practically all of the 700 customers gained during the last year at Topeka were connected to existing distribution lines, very few extensions being made. Although the efforts of the new-business department in using


INFORMATION

FOR USERS AND PROSPECTIVE USERS OF

ELECTRICITY

No red tape is necessary to secure Electric Service for your HOME or STORE. Simply phone 4080, or call at our office, and your order will receive prompt attention. A day's notice is usually sufficient to set a meter and connect the service wires.

THE COMPANY furnishes the meter, and runs the Service Wires from the lines to the House Free.

Prices on New Mazda Lamps:

25 Watt 20 candle power
40 Watt 32 candle power ..... 25 cents each
60 Watt 48 candle power
100 Watt 80 candle power ..... 50 cents
150 Watt 120 candle power ..... 80 cents

Larger sizes upon application.

Buy Your Lamps at the Electric Light Office and save from 15 to 30 per cent.

Meters are read approximately the 20th of each month, and Cash Discount for prompt payment is allowed if paid by 10th of month following.

NET RATES.

Minimum bill, 40c per month.
Residence lighting, 9c per 1000 watt hours.
Commercial lighting, 5c to 9c per 1000 watt hours.
Electricity Everywhere for Everything in the City supplied by—

The TOPEKA EDISON CO.

Telephone 4080

Office, 808 Kansas Avenue

OVER

Electrical Contractors Furnishing Wiring, Supplies and Fixtures

		Phone
H. B. Howard,	716 Kansas Ave.,	1377
E. P. Jordan,	118 W. 8th St.,	314
Keele Electric Co.,	706 Jackson St.,	3970-W
Machinists Electric Co.,	108 W. 8th St.,	634
E. L. Overton,	107 W. 6th St.,	922
Robbins Electric Co.,	916 Kansas Ave.,	1776-W
Topeka Electric Co.,	816 Kansas Ave.,	768

Any of the above contractors will furnish Estimates on Wiring and Electric Fixtures.

OVER

BUSINESS-GETTING CARD OF TOPEKA COMPANY

judicious advertising and circular letters have been quite successful, the early worth of house-wiring solicitors, who first educated the public electrically, is not discounted.

Utilizing Newspaper Clippings to Extend New-Business Field

It is considerably less difficult to persuade an industrial organization which is just preparing to build a factory to use central-station energy than it is to displace a private plant. The Edison Electric Illuminating Company of Brooklyn has therefore subscribed to newspaper-clipping bureaus for the purpose of informing itself of persons who are searching for manufacturing sites. To these persons the company sends letters and data pointing out the benefits of locating in Brooklyn and incidentally calls attention to the service it furnishes.

Not only are clippings collected regarding the expressed intention of changes in location, but also articles relating to new incorporations and to destruction of factories by fire, flood and hurricane, etc. In fact, any information is utilized regarding manufacturers who may of necessity or choice be waiting for an opportunity to locate where shipping, receiving, labor and manufacturing conditions are more desirable.

A copy of one of the first letters sent to manufacturers who may be forced to seek a new location because of fire follows:

"We have learned from a reliable source that a fire has recently occurred at your factory. This may prove a good opportunity for you to consider a change in location, and we are writing with the view of inducing you to locate in the borough of Brooklyn, New York City. In an enterprise such as yours the cost of power is an important consideration, and we believe that the low 'power' rates we are offering should play an important part in inducing you to locate in Brooklyn. Owing to extensive data on file in this office, we are in a position to give you invaluable information on factory sites, water-front loft buildings, transportation and freight rates, labor costs, and all other essentials which go to make up a successful manufacturing location. We offer to supply this information with absolutely no obligation on your part. Our object in doing this is, first, to see you locate in one of the most progressive industrial centers in America, and, second, to supply you with electric current from our mains for the complete operation of your plant. Will you please give us your opinion of this offer and let us know what data you would be interested in receiving?"

By assisting manufacturers to find a desirable site the company gains their confidence and increases its opportunities to close a contract for electric service. A card-index system is employed to keep track of the correspondence held with each prospective consumer and of the ultimate outcome of the company's efforts to secure his business.

Tungsten White-Way Lighting Supplants Arc Lamps at Arkansas City, Kan.

Ninety five-lamp ornamental lighting standards carrying one 100-watt and four 60-watt multiple tungsten lamps were recently installed to illuminate fourteen blocks in Arkansas City's business district. The residential streets are also lighted, 250 7.5-amp high-efficiency series-tungsten lamps being used for this purpose. Lamps on the multiple circuits are controlled by five time switches which light the entire installation at dusk and extinguish all but the top lamps at 11 p. m. The top lamps are extinguished at daylight. Situated as it is on top of a hill surrounded on all sides by broad valleys, the town may now be seen for many miles at night.

Energy for operating the street-lighting system is supplied by the Arkansas City Gas & Electric Light

LIGHTING STANDARDS AT ARKANSAS CITY

Company, of which Mr. A. L. Newman is secretary, treasurer and manager. The city pays for the energy at a flat rate of $3 a post per month, under the terms of a ten-year contract. Before the lighting system was rehabilitated arc lamps with overhead wiring were used, but the present installation is served by a three-conductor lead-covered cable laid in fiber conduit.

Voluntary Refund by Central-Station Company

The Minneapolis General Electric Company has notified the municipal authorities that it will refund more than $1,000 on bills rendered for electric service in fire-engine houses and other municipal buildings during the past year. This refund is the fulfilment of a promise by the central-station company to allow the city a discount on all except street-lighting bills, as the municipality is a large consumer in the aggregate. Accountants who are checking the monthly bills for electric service have reported through General Manager R. F. Pack that the refund will exceed $1,000 and may reach $1,200.

Desirability of National Electrical Code

From the fire insurance man's point of view the electrical code and careful inspection of electrical installations are altogether desirable, and at the same time, though these requirements may sometimes seem irksome, they are aids to electrical contractors' success, according to Mr. W. D. Gilsdorf, who recently addressed a joint meeting of the Louisville (Ky.) Electrical Clearing House and the Jovians, held in the assembly room of the Louisville Gas & Electric Company. It is the careful supervision of things electrical that has kept fires of electrical origin down to 2½ per cent, he said, while fires from other classes of causes run to as high a figure as 10 per cent. One effect is to make the electrical contractor's business a better business.

Less Frequent Billing for Small Customers

In discussing the problem of so popularizing the use of electricity that central-station service might be supplied to every household, however humble, Mr. Peter Junkersfeld, assistant to the vice-president of the Commonwealth Edison Company, Chicago, remarked at a recent joint meeting of the Chicago engineering societies that his company now has more than 250,000 customers. Among these a large percentage are small customers, and to continue to extend the service to such patrons, who for the time being do not return a profit, outside investors must be attracted. To attract this capital in the future, plans will have to be devised to decrease present high fixed charges. Mr. Junkersfeld suggested as possible solutions of this problem reduction in the frequency of billing, the increase of the customer density, and increased use of appliances by present customers.

Preparation of Motor-Service Layouts

In speaking on "Vital Points in Motor-Service Sales" before a convention of new-business solicitors in Ohio, Mr. R. A. MacGregor, Toledo, commented upon the necessity of carefully balancing investment cost against cost of operation.

A good way to strike an economic balance, he said, is to lay out a plant with a motor for every machine, figure the total investment for motors, wiring and installation, then estimate the amount of energy necessary to run such an installation, and thus arrive at the cost of operation. The same operation should then be gone through from a one-motor standpoint. This should give respectively the lowest and highest values for energy cost and the highest and lowest values for the investment. Different arrangements of grouping can then be laid out between these two extremes and a means determined which will give the largest percentage of saving on the investment for the money the prospective customer can be induced to spend.

If a series of layouts is presented, the prospective customer can have his choice of the layout above and the layout below the salesman's recommendations, and thus the customer is spared the feeling that something is being sold to him in which he has no voice.

General Overhead Allowance 21 Per Cent.

Too often the electrical contractor who has had his early training with pliers and soldering torch, rather than as a business man, overlooks the necessity for making adequate provision for the "overhead costs" of doing business when scheduling the prices of supplies and appliances which he installs or puts on his counter for sale. Figuring closely, he is likely to fix selling prices which do not include any allowance for rent, light, heat, store attendance, office accounting, and the other numerous costs of doing business—let alone any provision for profit on the transaction. A successful electrical contractor in a Wisconsin city of 30,000 has made it a point to include in all cost prices of supplies an allowance of at least 21 per cent to cover "overhead," before the item of profit is added. This figure of 21 per cent is applied to all wiring supplies, devices, etc., but even this amount has been found insufficient in the case of reflectors and glassware, where it has been proved necessary to charge at least 25 per cent on account of breakage and damage incurred in handling.

The Basis of Establishing Credit Limits

Speaking before the recent meeting of the Electrical Credit Association of Chicago on the subject of credit limits as viewed from the standpoint of the wholesale dealer in electrical supplies, Mr. Thomas I. Stacy, Electric Appliance Company, Chicago, remarked that in some offices a credit limit is placed on the customer's account as soon as it is opened and becomes almost as much a part of the account as the name itself and almost as unchangeable.

The man who pays when his account is due, said Mr. Stacy, soon establishes unlimited credit, while, on the other hand, the customer from whom collections are made with difficulty will soon have his credit withdrawn. If a credit limit is to be established in the case of any customer, said the speaker, it should be only tentative and its use should be chiefly that of a warning signal in the event that the value assigned is much exceeded.

In many lines of general business the rule has been that the credit allowance of a customer should not exceed 30 per cent of his net worth. But this proportion cannot apply in the electrical business, said Mr. Stacy, for some customers, as, for example, electrical contractors, have doubtless carried credit favors amounting to more than even their entire tangible assets. Every fact which bears on the customer's character should receive consideration. Particular caution must be exercised in the case of the over-ambitious customer who wants to run before he has learned to walk. On the other hand, the manufacturer or jobber can afford to increase to the limit the credit allowed on the account of the conservative man whose business is management.

Mr. Alex. Klein, of M. Klein & Sons Company, Chicago, declared that any deficiency in the moral character of the customer makes him a dangerous risk as a creditor. If the candidate for credit is reckless in his business methods, he is not entitled to credit. One rule suggested by Mr. Klein for the assignment of credit limits was that 10 per cent be considered a fair value.

Integrating Sphere Equipped for Testing Gas-Filled Lamps

Some photometrists have objected to rating gas-filled lamps on their total flux per watt required on the ground that it is impossible to use an integrating sphere rapidly. At the Electrical Testing Laboratories, New

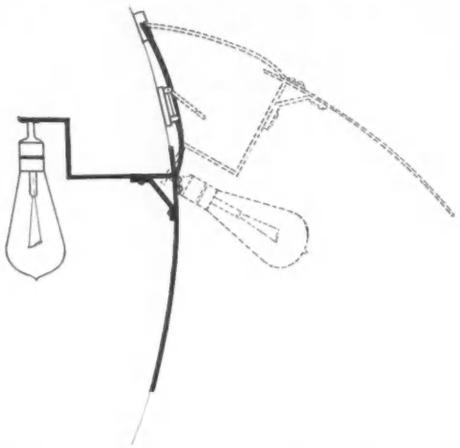


FIG. 1—CONSTRUCTION OF PANEL AND LAMP BRACKET

York City, an integrating sphere has been equipped so that lamps can be rapidly inserted or removed without danger of breaking the bulbs. From one side of the sphere a rectangular section has been removed and a panel supporting a lamp bracket and socket has been

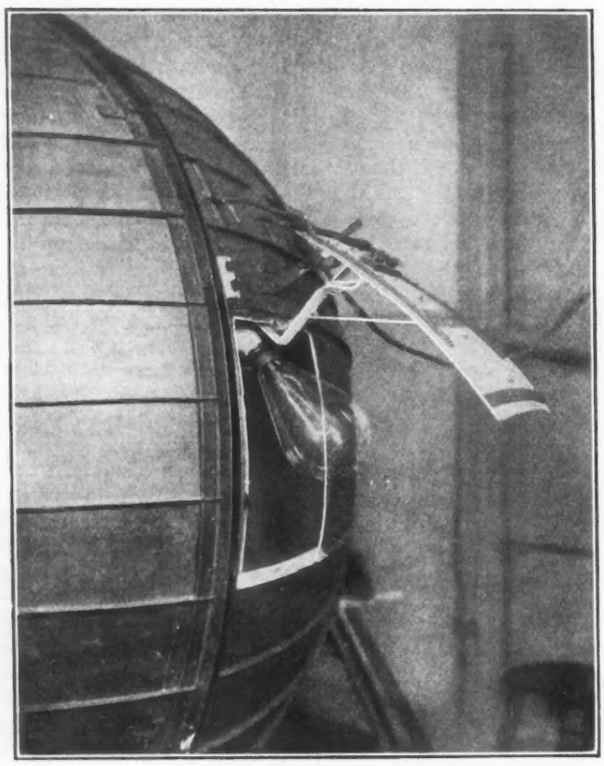


FIG. 2—INTEGRATING SPHERE EQUIPPED FOR RAPIDLY TESTING GAS-FILLED LAMPS

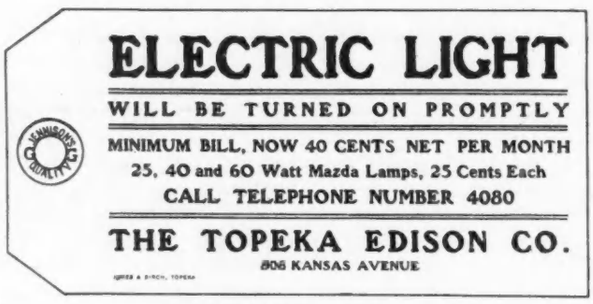
hinged to the exterior of the sphere so it can be swung outward for inserting or removing the lamp and can be closed during the test to prevent leakage of light through the opening. The construction of the panel and lamp bracket is clearly shown in the accompanying illustration and drawing. The lamp bracket, lamp leads and concave surface of the panel are coated with a substance similar to that used on the interior of the sphere so that no errors will be introduced in the test results by the conversion of the flux-measuring apparatus. When the panel is swung outward it opens a switch in the lamp circuit, thereby extinguishing the lamp. The panel is held in its extreme outward position by a notched lever. Energy is conveyed to the lamp socket through a flexible cable. When the panel is closed it automatically closes the lamp-circuit switch so that the photometrist has very little to do besides taking measurements.

Marshall Field Electric Trucks Save 40 Per Cent

Marshall Field & Company, Chicago, operate a fleet of more than 200 electric trucks and delivery wagons. After experience with both gasoline and electric trucks for haulage and delivery work, Mr. Stanley Field, first vice-president of the company, recently made the comment that with electric trucks operated at an expense of $8 per day Marshall Field & Company are able to perform delivery service which cost $13 per day with gasoline trucks.

Keeping Wired Houses Connected

Men sent out by the Topeka (Kan.) Edison Company to carry out disconnect orders are provided with tags, both sides of which are printed with the inscription in the illustration herewith. The tags are tied to elec-


ELECTRIC LIGHT
WILL BE TURNED ON PROMPTLY
MINIMUM BILL, NOW 40 CENTS NET PER MONTH
25, 40 and 60 Watt Mazda Lamps, 25 Cents Each
CALL TELEPHONE NUMBER 4080
THE TOPEKA EDISON CO.
806 KANSAS AVENUE

TAG FOR ELECTRIC FIXTURE

tric fixtures in conspicuous places so that the attention of a prospective renter or a new tenant will be attracted. "By thus calling attention to the company's prompt service and the 40-cent minimum bill," says Mr. B. J. Long, contract agent, "the tags are instrumental in securing without solicitation many reconnections in wired houses occupied by renters."

Municipal Competition in Electric Merchandising

Hannibal, Mo., has a population of 18,341 and owns its electric plant. The electric plant is under the direction of a municipal board of public works appointed by the Mayor to serve six years at annual salaries of $100. To encourage day service a municipal supply store was installed in the office of the Board of Public Works in the city hall. The store carries a full line of supplies, has a clerk on hand all the time to wait upon customers and to demonstrate the appliances, and makes sales at cost plus 5 per cent for profit. The price feature, however, is not the only item through which the municipal store competes with local equipment stores, for the municipal board advertises liberally in the daily papers in competition with the retail merchants, the displays emphasizing the conveniences and economy of electricity and thus stimulating the business generally.

NEW APPARATUS AND APPLIANCES

Automatic Reverse-Current Circuit-Breaker

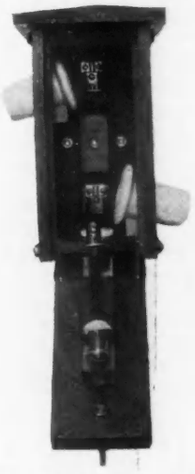
An automatic reverse-current circuit-breaker designed for use with small storage-battery lighting plants has been developed by the Gray Electric Company, Springfield, Ohio. When the engine is run at normal speed this

REVERSE-CURRENT CIRCUIT-BREAKER

circuit-breaker automatically connects together the battery, dynamo and lamps, so that the battery is properly charged and the energy for the lighting circuit is taken direct from the dynamo. If the engine should slow down or stop, the circuit-breaker automatically disconnects the dynamo from the battery and the lamps and connects the battery to the lamps. A 15-amp circuit-breaker is shown in the accompanying illustration. No springs or resistors, it is declared, are used in the construction of this device.

Primary Cut-Out

Several expulsion-type primary cut-outs with ratings of 15 amp at 6600 volts, 75 amp at 6600 volts and 100 amp at 2500 volts, designed for outdoor use, have recently been developed by the General Electric Company, Schenectady, N. Y. When the door of the device is opened the fuse holder is automatically disconnected from the circuit. The ring bolt and latch with which the door is fitted are separated from all



6600-VOLT PRIMARY CUT-OUT WITH EXPULSION FUSE

live metal parts. The box is of well-seasoned ash, which is oil-impregnated, and is coated on the outside with black japan. On the bottom of the box is an indicator in the form of a brass card receiver which is placed under the gas outlet of the expulsion fuse. Into this receiver can be slipped a white card, a piece of oiled paper or a very thin sheet of white celluloid, which forms a white target against the black background of the box and which can be readily seen from the ground. The blowing of the fuse causes a discharge of gas which dislodges the card from its receiver. This feature obviates the necessity of climbing the pole on which the cut-out is placed to ascertain the condition of the fuse.

Vehicle Battery-Charging Outfit

To meet the demand for low-cost easily operated battery-charging apparatus, adaptable for use in private garages, the Lincoln Electric Company, Cleveland, Ohio, has developed the small motor-generator set shown in the illustration herewith. The motor is a single-phase, four-pole, squirrel-cage machine, and it drives a compound-wound interpolar generator. Connected to the set by a six-wire cable is a control cabinet which contains a four-pole knife switch and a field rheostat. The two middle switch poles are equipped with extra clips, to which are attached the terminals of the shunt field, in

CHARGING SET FOR PRIVATE GARAGE

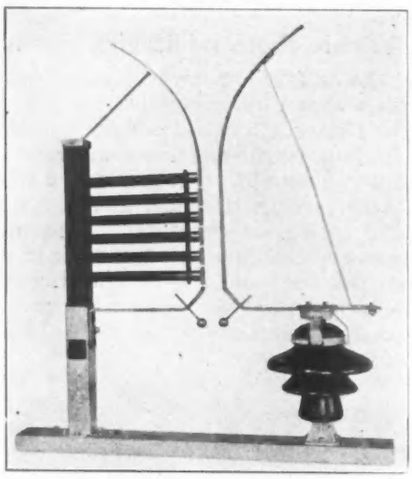
the circuit of which is the rheostat. The set is started from the battery.

When the switch is closed the two clips connected to the generator field are engaged, and therefore the shunt field is excited; then the battery is thrown across the armature and starts the generator as a motor. When the set is brought up to speed the alternating-current circuit is closed and the generator starts to charge the battery. The generator is so compounded, the manufacturers declare, as to give practically constant-potential charging, thus providing automatically the tapering charge with a low finishing rate which is essential to the long life of the battery. Guide marks are provided on the field rheostat so that each set may be arranged for any four combinations of cells, such as thirty, thirty-two, thirty-five and thirty-six cells or thirty-eight, forty, forty-two and forty-four cells. A rheostat handle with a limited travel is provided so that the field strength may be varied in order to regulate the finishing rate of

the battery from 3 amp to 7 amp. In case the energy supply is cut off, the set continues to run, the generator acting as a direct-current motor fed from the battery; when the alternating-current supply is restored the generator resumes the charging operation.

Automatic-Resistance Horn-Type Arrester

The function of a lightning arrester is to offer instantaneous relief from abnormal voltages and to prevent the flow of dynamic or generator current, after



AUTOMATIC-RESISTANCE HORN ARRESTER

the abnormal voltage has been relieved, without producing any disturbances on the system which it protects.

The automatic-resistance horn arrester recently placed on the market by Schweitzer & Conrad, 1770 Wilson Avenue, Chicago, for use on circuits of from 11,000 volts to 66,000 volts, is an ingenious device for accomplishing the above function. As seen in the illustration, the arrester consists essentially of a horn-gap and a number of resistance units so arranged that as the arc rises up the horn's resistance is automatically cut in, step by step, into the circuit. Thus, without any moving parts, the current is rapidly reduced so that the arc breaks easily and without any serious voltage rise. A sphere-gap is also inserted in parallel with the horn-gap to assist the dissipation of very high frequency waves such as occur from charging an adjacent line, switching and other similar causes.

The chief difficulty experienced with simple horn-gaps has been that of breaking the arc rapidly and permanently, without setting up oscillations and dangerous pressure rises. The current is often so large that the arc is slow to break, and when it does finally break the rupture comes so suddenly that a high voltage rise occurs, which may cause the arc to start across the bottom of the horn again.

The height of the gap illustrated is comparatively small for a given voltage. Unlike most horn-gaps, the sides of these horns rise parallel to each other until the resistance units are passed, above which the horns diverge. As the dynamic current rises up the horns it is cut down in value as the increasing resistance becomes effective and the strength of the arc is weakened accordingly. When the divergent portions of the horn are reached the thermo-dynamic and electro-dynamic forces co-act to drive the arc, or what remains of it, up the horns to self-extinction. It should also be noticed that while the discharge goes directly across the horn or sphere-gap to earth, the dynamic current, after the first instant, will, owing to the arc's tendency to rise upward, necessarily go to ground through resistance.

When an arc exists in a circuit containing inductance and capacity, oscillations tend to be set up. Such oscillations can, however, be prevented and the oscillation dampened out if a resistance equal to, or greater than, the critical resistance be connected in series. This the arrester described accomplishes automatically.

Adjustment for different operating voltages is made by decreasing or increasing the horn-gap, a matter of loosening two screws. The resistance units are strong, of ample carrying capacity, and unaffected by weather.

The arrester, it is explained, has a very large discharge capacity and thus is not only able to discharge large quantities of lightning but can take care of both continuous and recurrent discharges with ease. It is also sensitive to voltage rises and hence is recommended as efficacious for the protection of equipment and for installation at entries to stations and substations, whether of the indoor or outdoor type. For the latter class of stations, where the arrester may be isolated and forgotten after being once installed, the substantial construction, the absence of moving parts, and the fact that the device described needs no regular attention, makes it particularly desirable. The insulators used on these arresters are so chosen that the spill-over voltage is several times that of the arrester. The insulators are thus able to withstand successfully the piling up of steep-front traveling waves of such potential as the arrester is designed to discharge.

The arrester is securely mounted on a substantial steel channel frame. It is low in first cost and involves no subsequent expense for maintenance.

Automatic Cut-In and Cut-Out Switch

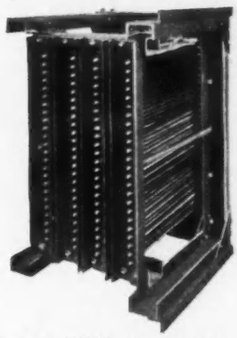
An automatic switch designed for use on low-voltage switchboards of small lighting plants is shown in the accompanying illustration. It is placed between the generator and battery and automatically connects the generator to the line when the voltage reaches a predetermined value, usually 38 volts. In the same way it automatically breaks the circuit when the battery voltage exceeds that of the generator, or, in other words, when there is a reversal of current. The moving con-

AUTOMATIC SWITCH FOR SMALL LIGHTING PLANTS

tact is in the form of a disk which is cupped and slotted so as to insure a tight, even contact. The disk is weighted and cup-shaped to prevent sticking and consequent burning of contact points. The device is being made by the Hartman Electrical Manufacturing Company, Mansfield, Ohio.

Regulators

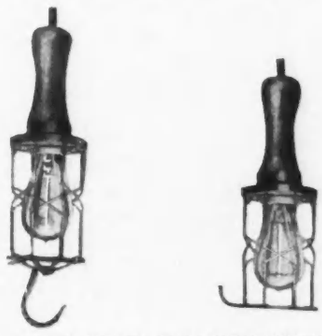
For regulating the exciting current of large generators two regulators of the rectangular and the face-plate or circular type have been designed by the General Electric Company, Ltd., London, England. A recently developed rectangular regulator is shown in the accompanying illustration, the resistor of which consists of strips. If the size of the generator permits, the resistor is made of wires. A framework of steel is employed to provide for the expansion and contraction of the strips. Means have also been provided for adjusting the strip tension to eliminate the sag of the strip, and instead of one adjustment for the whole length of the strip, an individual adjustment is provided for each turn of the strip. By means of two sets of screws the pressure on the contact brushes and the position of the brushes can be adjusted independently. The regulator shown in the illustration is designed for use with a 5000-kw turbo-generator.



REGULATOR FOR 5000-KW TURBO-GENERATOR

Guards for Portable Lamps

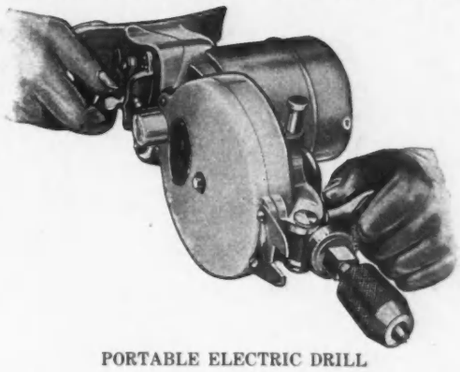
Two types of non-detachable guards for portable lamps are shown in the accompanying illustrations, that illustrated in Fig. 1 being equipped with an open end and that in Fig. 2 with a closed end. The open-end guard is designed chiefly for pit work. In the closed-end guard the end piece is hinged to the cage by means of a rivet to allow for replacement of the lamp. A thumb nut is employed to hold the end piece fast. The open-end guard is equipped with a side hook as shown in the illustration. The cage is of steel and the wires are electrically welded. The closed-end guard is 15 in. long, including hook and handle, and weighs approximately 25 ounces. The open-end lamp guard is 10 in. long over all, including handle, and weighs 20 ounces. Both guards are substantial in construction and are designed for use with circuits, with pressures up to 600 volts. The guards are being placed on the market by the Electric Service Supplies Company, Seventeenth Street and Cambria Street, Philadelphia, Pa.



LAMPS EQUIPPED WITH NON-DETACHABLE GUARDS

Electric Breast Drill

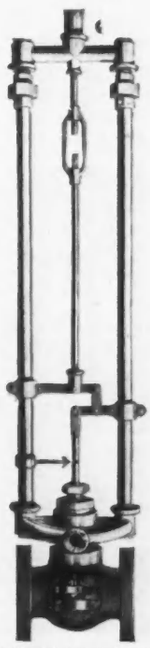
The electric drill shown herewith operates on both alternating current and direct current, and the spindle speed is regulated automatically by the amount of pressure the operator places back of the drill. The switch is operated by the lever outside of the switch cover and is used to start, stop and reverse the motor. The lever is spring-seated on the off or neutral position, and by throwing it to either extreme position the motor is run forward or in the reverse direction, according to which direction the lever is turned. The motor can be reversed no matter whether it is running at full speed or not. The drill is being manufactured by the Temco Electric Motor Company, Leipsic, Ohio.



PORTABLE ELECTRIC DRILL

Feed-Water Regulator

A thermostatically controlled feed-water regulator made by the McDonough Automatic Regulator Company, Detroit, Mich., is illustrated herewith. It consists of a feed valve, two headers and two expansion tubes, which are connected in parallel through links to the feed-valve stem. Adjustment of the valve is provided by the turnbuckle shown, and a pointer indicator shows the position of the valve while the regulator is in operation. The regulator is installed in an inclined position and is supported by the feed pipe with the connections made to the water column as illustrated. When in operation the



THERMOSTATICALLY CONTROLLED FEED-WATER REGULATOR

lower ends of the tubes are filled with water and the upper with steam. As the water falls or rises in the boiler it moves up and down a corresponding distance in the regulator tubes, thereby presenting a greater or less area in the tube surface to the hot steam, causing the tubes to expand or contract accordingly.

Large-Sized Surface Condenser

What is said to be the largest surface condenser ever built was recently installed in the Waterside station of the New York Edison Company to serve a 30,000-kw General Electric tandem-compound turbine. The condenser is of the radial-flow type and was made by the Westinghouse Machine Company, East Pittsburgh, Pa.

The unit has a condensing surface of 50,000 sq. ft., and the solutions of some new and difficult problems are represented in its design. Long or restricted passages for the steam are avoided in order to keep the pressure drop as low as possible. The nest of tubes is placed non-concentric to the condenser shell so that steam enters around the whole periphery. Such an arrangement is said practically to double the area for the admission of steam and hence produces a velocity one-half that of smaller-sized units in which the shell and nest of tubes are concentric. The air offtake consists of two parallel plates extending the entire length of the condenser, and the air is removed, it is asserted, when the temperature is the lowest and its density is the greatest.

PERFORMANCE DATA OF CONDENSER

Output of turbine in kw	19,000	30,000
Vacuum at turbine exhaust (in.)	29.20	29.07
Vacuum at air pump (in.)	29.23	29.09
Injection temperature (deg. Fahr.)	54	53
Discharge temperature (deg. Fahr.)	60	64
Hotwell temperature (deg. Fahr.)	75	81

In Fig. 1 the condenser is illustrated with the end plate removed prior to its installation. The water enters the condenser at the side, passes through the central section and returns through the outer annular section. Heat removal is thus facilitated because the temperature difference or "heat head" between the steam and water remains more nearly constant throughout the condenser. The two small openings on the side of the upper half of the shell are for the air-pump connections. A Westinghouse-Leblanc air pump is employed with the apparatus.

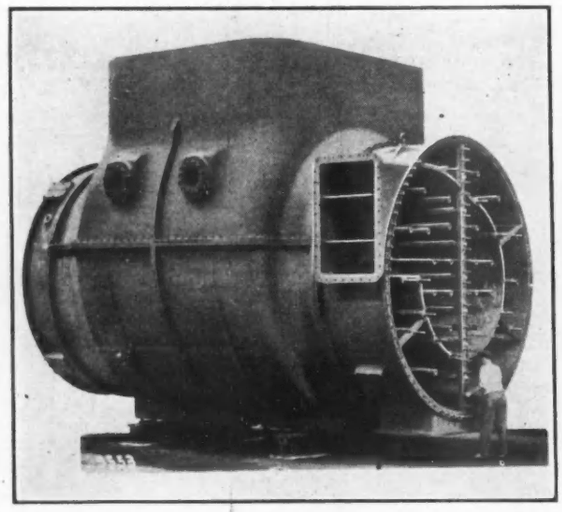


FIG. 1—50,000-SQ. FT. RADIAL-FLOW SURFACE CONDENSER

A vacuum greater than 29 in. (referred to a barometric pressure of 30 in.) has been maintained at full load, and the hot-well temperatures closely approach those of the entering steam. In the accompanying table are given some data of tests, including those obtained with the turbine, giving its full-rated output of 30,000 kw and also an output of 19,000 kw.

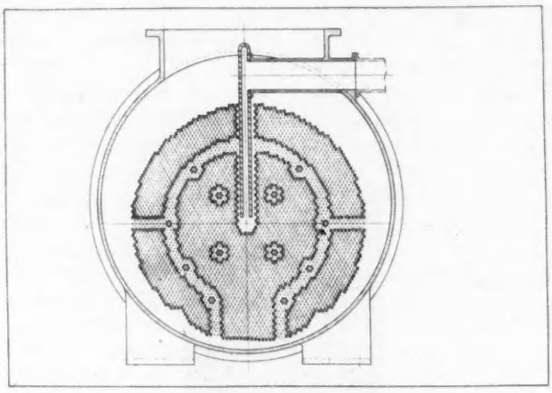
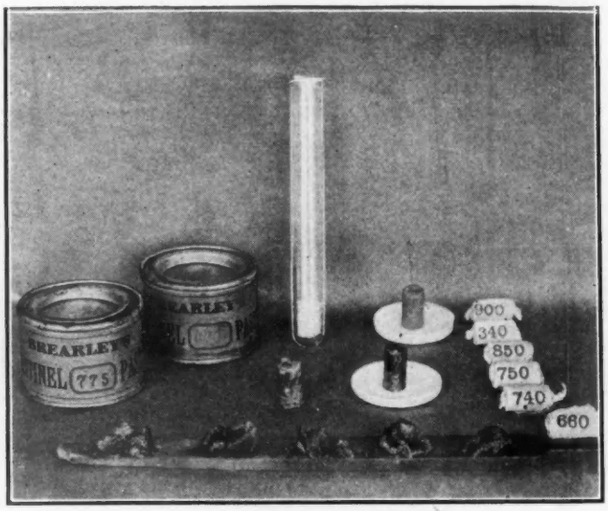


FIG. 2—SECTIONAL VIEW OF CONDENSER

Measuring High Temperatures by Melting of Metallic Salts

A method for measuring high temperatures, which has just been developed by the Carl Nehls Alloy Company, Detroit, Mich., is based on the principle that when various kinds of metallic salts are mixed in different proportions they will melt at different temperatures. The method can be employed in place of pyrometers and temperatures varying between 425 deg. Fahr. and 2425 deg. Fahr. can be determined. By melting the salts in this manner pyrometers may also be checked. The salts may be kept in solid cylinders, 7/16 in. in diameter and ¾ in. long, similar to those shown standing in the accompanying illustration.



METHOD OF MAKING UP MIXTURES OF SALTS

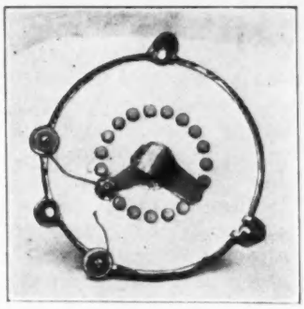
The cylinders shown wrapped up are marked with numbers which designate the temperature at which they will melt. For all temperatures below 932 deg. Fahr. the "Sentinel" pyrometers, as they are called, can be used in air-tight glass tubes, similar to the one shown standing up in the accompanying illustration, and the

salts can be used over and over again. By means of the porcelain saucer shown the salts are not wasted.

The salts are also made up in the form of a paste. Enough paste is inclosed in one of the tins shown in the illustration to make two or three hundred determinations. Pastes with various melting temperatures can be placed on a steel bar and inserted into furnaces, ovens, retorts, flues, gas mains, steam pipes, etc., to determine the temperature at which they are operating. The salts that melt down and those that remain solid will indicate the difference in temperature between the two substances.

Field Rheostat for Small Generators and Motors

A field rheostat for small generators and motors which is equipped with eighteen control steps is being made by the Ward Leonard Electric Company, Bronx-

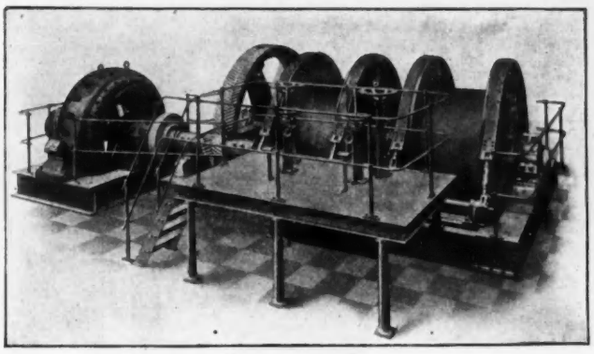


SMALL FIELD RHEOSTAT

ville, N. Y. The device is 6 in. in diameter and is finished in enamel. The rheostat can be mounted on the front or back of the board and can be quickly changed from one kind to the other. A hand-wheel is provided when the device is attached to the back of the board.

Motors for Mane-and-Tail Hauling System

Large-sized motors designed for hauling purposes in coal mines have been developed by the General Electric Company, Ltd., London, England. In the accompanying illustration is shown a 600-hp motor directly connected to a large mane-and-tail outfit designed to draw its load at a mean rope speed of 10 miles an hour. The motor operates on a 3000-volt, forty-cycle, three-phase supply



600-HP MOTOR FOR MANE-AND-TAIL HAULING

and runs at a speed of 400 r.p.m. It is equipped with slip-rings which are inclosed in flame-proof covers. The gearing between the motor and the drums is of steel. Rolls 6 in. in diameter are employed, the length between flanges being 3 ft. and the diameter of the flanges being 9 ft. The drum shaft is 12 in. in diameter.

Improved Motor-Driven Pipe-Bending Machine

The problem of bending pipes and tubing for power-house installations and various conduit systems, for which many kinds of bends are employed, often neces-

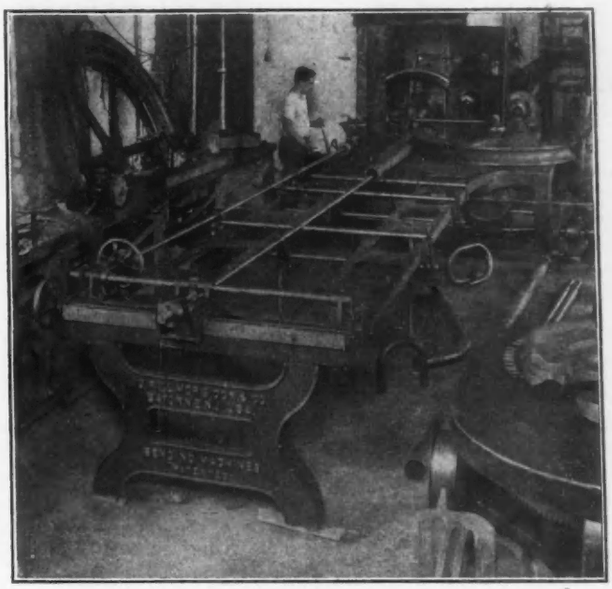


FIG. 1—MOTOR-DRIVE PIPE-BENDING MACHINE

sitates considerable thought and attention, especially if the process is done by hand. Some twenty-two types of machines for bending pipe cold without filling, ranging in size from a small portable bench machine suitable for electricians or plumbers to large motor-driven and hydraulic machines which will not only bend pipe but channel beams, I-beams, etc., as well, are being made by the J. Fillmore Cox Engineering & Tube Bending Machine Company, Bayonne, N. J.

In Fig. 1 is shown a recently developed machine of the semi-automatic quick-change type driven by a 5.5-hp variable-speed, reversible General Electric motor. The machine is equipped with an automatic degree stopping device, emergency lever and safety clutch. It is also pro-

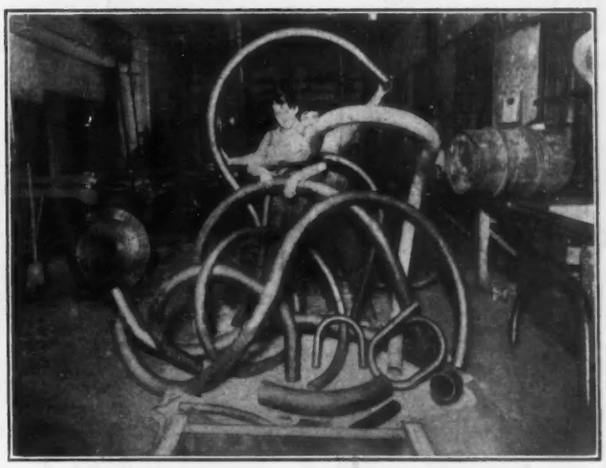


FIG. 2—VARIOUS TYPES OF BENDS

vided with a quick-setting arrangement and a special duplicating device.

A U-bend with 18-in. centers can be made by this machine on a 4-in. steel or iron pipe which is threaded at both ends, the manufacturers claim, in one minute. The apparatus is designed to bend pipe into conical helices,

open or closed coils, or radical or die bends. In Fig. 2 are shown some typical bends made for power-station requirements. The pipes are of various materials and range in size from 1 in. in diameter to 6 in. The radii of the bends are from 3 in. to 3 ft. and the time taken for each operation was from 0.5 minute to 2.5 minutes.

Gear-Tooth Turbine Driving Portable Electric Lighting Outfit

A turbo-generator set which will operate on any steam pressure between 30 lb. and 50 lb. is being manufactured by the M. M. Manufacturing Company, Independence, Kan., for use in lighting oil-well drilling outfits and small coal mines and for night work about threshing machines, on steam shovels and in quarries. The moving elements in the turbine consist only of two gears, which revolve with minimum clearance in iron housings. Steam enters the turbine on a horizontal line, striking the gears at the point where they are in mesh, and emerges at the opposite side of the machine as the gear teeth turn, permitting intermittent flow of the vapor. The 110-volt, 0.5-kw compound-wound generator which is direct-connected to one of the gears is driven at 2000 r.p.m. A muffler similar to the type used with gasoline engines is attached to the turbine exhaust to reduce the howling noise produced by the intermittent flow of steam through the gears.

In equipping the outfit to withstand rough handling it has been arranged so that the turbo-generator need not be taken from the box. Steam-pipe connections can be made from the outside, and plug-socket connections are provided for all lamps, so that no knowledge of wiring is necessary. Ordinary 100-watt tungsten lamps are used in the projectors, it being the common practice to set these reflectors in a position adjacent to the work so that they throw a flood of light on the area of operation.

Inclosed Oil-Break Switches

Fully inclosed oil-break switches for three-phase service are shown in the accompanying illustrations. The switching apparatus is mounted on a sliding carriage and is connected to the busbars or cables through plugs. When the carriage is withdrawn the circuit is broken. Two types of switches are being made, that shown in Fig. 1 being designated by the manufacturers as the "O J1" type and that illustrated in Fig. 3 as the "O J2" model. The former has a rating of 120 amp with pressures up to 650 volts and of 50 amp with pressures of from 2200 volts to 3300 volts. The rating of the latter is 500 amp for pressures up to 650 volts and 120 amp for emfs of from 2200 volts to 3300 volts.

On withdrawing the switch and removing the oil tank, the contact-delaying devices, overload-adjusting devices and low-tension fuses are made accessible, and by removing four screws the entire switching apparatus may be removed in one piece, when every part is fully exposed. Access to the connecting chamber is obtained by removing a large cover plate at the back and cover plates on the sides or top and bottom where exposed.

The handles are interlocked so that it is impossible to withdraw or close the contact unless the oil switch is in the off position. The box cannot be opened and the oil tank cannot be removed unless the circuit is open. The cover must be first closed before the circuit can be closed, and it is impossible to close the switch accidentally without first replacing the oil tank. Catches prevent the switching part being removed entirely.

The switch is closed by means of a handle at the side. All live switch parts above the oil level are insulated with porcelain. The tripping device is delayed by means of a self-aligning plunger in a small dash-pot. Large flange joints are provided between the castings to insure good ground connection throughout the frame. The switches are being made by the British Thomson-Houston Company, Ltd., Rugby, England.

FIG. 1—SMALL OIL-BREAK SWITCH WITH CARRIAGE WITHDRAWN AND COVER OPEN

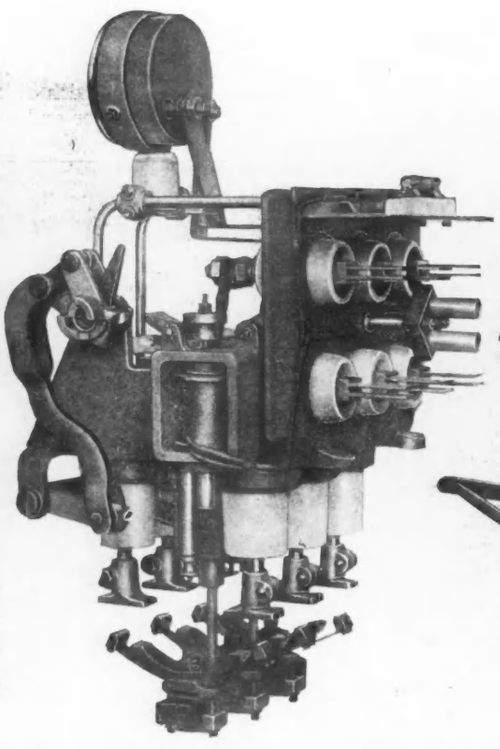


FIG. 2—SWITCH MECHANISM FOR LARGE SWITCH IN OPEN POSITION

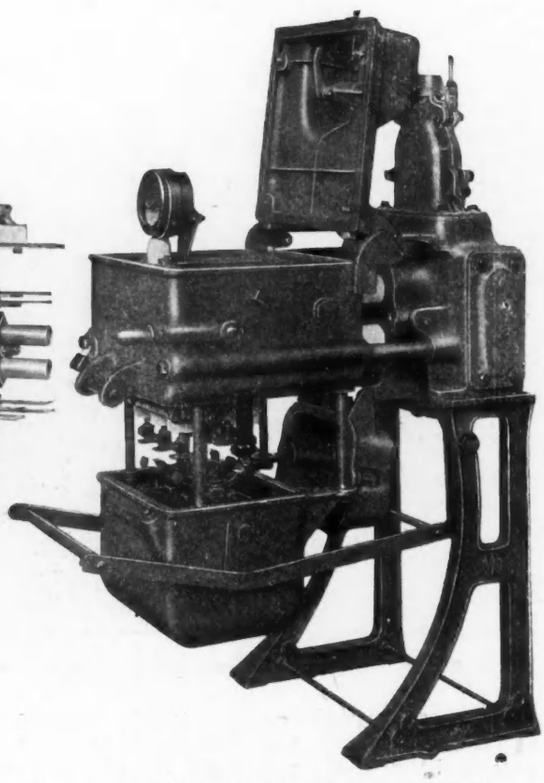
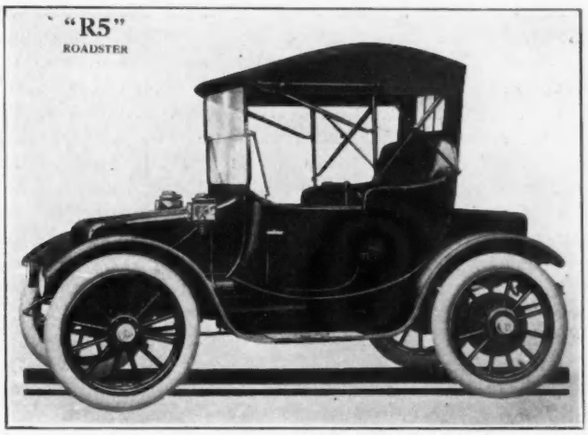


FIG. 3—LARGE SWITCH WITH CARRIAGE WITHDRAWN, COVER OPENED AND TANK LOWERED

Electric Roadster

A 1915-model light-weight electric car designed chiefly for business men is shown in the illustration herewith. The car has a wheel base of 92 in. and is



LIGHT-WEIGHT ELECTRIC PASSENGER VEHICLE

worm-driven. Steering is accomplished by means of a side lever. The tires are 33 in. by 4.5 in. The battery equipment consists of 41 "Exide" cells. The car is being placed on the market by the Rauch & Lang Carriage Company, Cleveland, Ohio.

Electric Silver-Burnishing Machine

The machine shown in the accompanying illustration consists of a wooden cylinder, which is three-quarters filled with smoothly polished steel balls, varying in size from about 0.25 in. in diameter to about the size of a very small pinhead, and smooth blunt plugs, and is used to polish silverware. Steel plates divide the cylinder into several compartments for different classes of material. The silverware is placed in the cylinder and is covered with hot soapsuds. The pieces of silver are moved

MACHINE FOR POLISHING SILVERWARE

to the center by centrifugal force, and the steel balls and slugs roll over and around them. The machine has recently been placed on the market by the Tahara Company of America, Glenwood Avenue and Second Street, Philadelphia, Pa., and is operated by a motor made by the Robbins & Myers Company, Springfield, Ohio.

Test Runs with Electric Passenger Cars

Test runs were recently made in Louisville, Ky., with two Rauch & Lang electric passenger vehicles, one car being a 1911 model brougham and the other a 1911

TABLE I—RESULTS OF TEST RUN WITH ELECTRIC BROUGHAM

Mileage	Volts Standing	Volts Running	Amp.	Speed, Miles per Hour
Start	88	84	25	11.5
11.15	..	82.5	25	11.5
18.45	84	82	25	11
24.65	..	82	25	11
31.85	83	81	25	11
84.65	..	76	25	10
94.25	..	68	25	9

model coupé. Each car was equipped with a forty-cell "Revivo" battery, made by the Cook Railway Signal Company, Denver, Col., a description of which appeared in the ELECTRICAL WORLD of Jan. 4, 1913.

Before the test with the brougham its battery was charged for ten hours at a 15-amp-hr. rate, the charg-

TABLE II—RESULTS OF TEST RUN WITH ELECTRIC COUPÉ

Mileage	Volts Standing	Volts Running	Amp.	Speed, Miles per Hour
Start	..	84	25	15
10	..	84	25	15
20	..	83	25	15
30	..	82	25	15
34.6	84	..	..	..
40	..	82	25	14
50	..	81	25	14
51.2	83	..	..	..
60	..	80	25	14
70	..	78.5	25	14
78.4	80	..	..	..
80	..	77	22	13
90	..	72	22	13
95.6	78	..	..	..
95.6	..	55	21	10
103.1	..	55	20	10
105.1	..	48	20	8
.....	68	..	..	..

ing emf being 96 volts and the standing emf 88 volts. In Table I are shown voltages at various periods of the run and other data. In Table II are shown the results obtained on a test run with the coupé. A total mileage of 105.1 miles was obtained with the coupé and 94.3 miles with the brougham.

Automatic Voltage Regulators

BY W. H. ACKER

The voltage regulation of lamp and motor feeders is a phase of central-station operation that is being recognized more and more as one of the essential factors of successful operation. Perhaps no feature of the service more easily creates dissatisfaction among customers than do wide fluctuations in voltage. The amount of compensation required to maintain constant potential at the individual lamp is different in every feeder, depending upon the length of the feeder and the amount and duration of the load. It is evident, therefore, that the only satisfactory method of obtaining good regulation on any system is by the independent regulation of each feeder. The exceptionally good voltage regulation which forms a part of the service rendered its customers by

the Mahoning & Shenango Railway & Light Company in the city of Youngstown, Ohio, and vicinity, is due primarily to the use made of automatic induction regulators.

At the North Avenue power station there are installed sixteen large motor-driven automatic induction feeder regulators, together with primary and secondary relays, shunt and series instrument transformers and line-

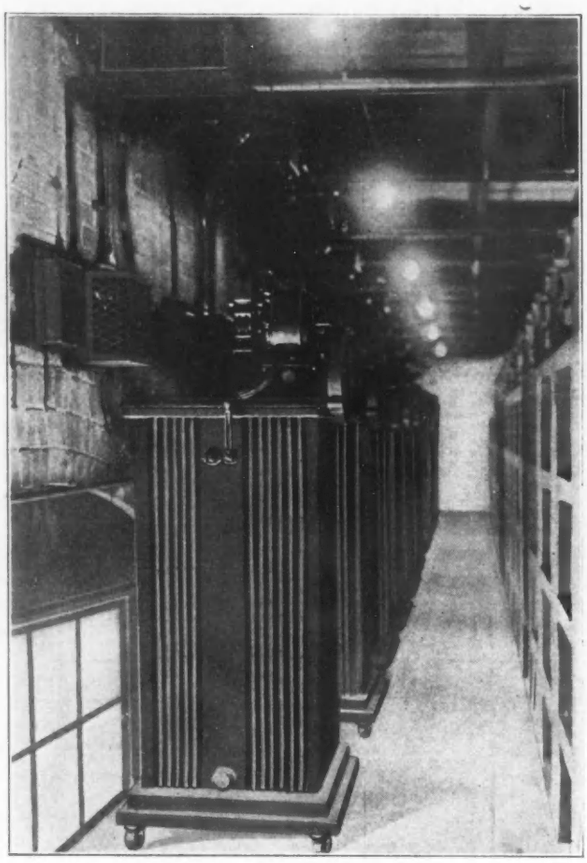


FIG. 1—FEEDER REGULATORS

drop compensators. The regulators are positive in action and are free from the detrimental effects due to "overrunning" or "hunting," which are eliminated by the use of a quick-acting magnet brake and of compounding coils in the primary relay. Normally the brake is locked against the drum on the shaft of the motor by a strong spring, but at the instant current is applied to the operating motor circuit the brake is magnetically released, allowing the motor to start quickly and with the minimum starting current. Chattering of the primary relay, which is one cause of "hunting," is eliminated by the use of compounding coils. These coils are connected in series with the relay circuit, so that when the contacts close in a certain direction the coil becomes energized and holds the contacts firmly closed until the voltage of the line has changed to within a certain definite percentage of the normal relay setting.

The degree of refinement of the voltage regulation obtained at the center of distribution, which in some instances is two or three miles from the station, is well shown by the two graphic meter records reproduced herewith. These records, covering a period of two days, were taken at the same time and are placed side by side in order to show more clearly the actual conditions. The ammeter chart shows accurately the load in amperes at approximately 2200 volts on a certain single-phase feeder supplying energy to both lamps and single-phase motors and by connection with another feeder, to two-phase motors. The day load consists principally of motors placed in service about 6 a.m. and taken off about 5 p.m., with a slight drop in load for approximately thirty minutes at noon hour. The night load consists principally of lighting, which begins to come on at about 6 p.m., reaches a maximum around 8 o'clock and then gradually falls off until midnight, when it becomes very small and continues so until about 6 a.m. It is readily seen from the chart that the feeders are carrying an average load of approximately 150 amp for eighteen hours per day, this being the usual load for six days per week. It will also be noted that for about five hours during the afternoon the regulator is operated at approximately 33 per cent overload, the normal rating being 150 amp.

The voltmeter chart was taken at a customer's lamp socket near the center of distribution of this particular feeder, which is approximately three-fourths of a mile from the station. The voltage regulation, as indicated by the graphic record, is exceptionally good considering the large proportion of day-motor load carried. In connection with this chart it should be noted that the regulators require approximately sixteen seconds to travel from the position of maximum "buck" to the position of maximum "boost."

One of the noteworthy features of this installation is its compactness and accessibility, as may be seen from Fig. 2. The regulators, which are mounted on a gallery having a width of only 50 in., are so arranged that each one can be entirely disconnected from the feeder circuit in a few seconds, the feeder then receiving energy directly from the busbar.

The relays are placed on the wall at the back of the regulators, while the transformers and auto-transformers are mounted on the ceiling directly above. This arrangement minimizes the space required without impairing the accessibility of the apparatus, the entire installation having a neat and uniform appearance. Considerable ingenuity was required to install the sixteen

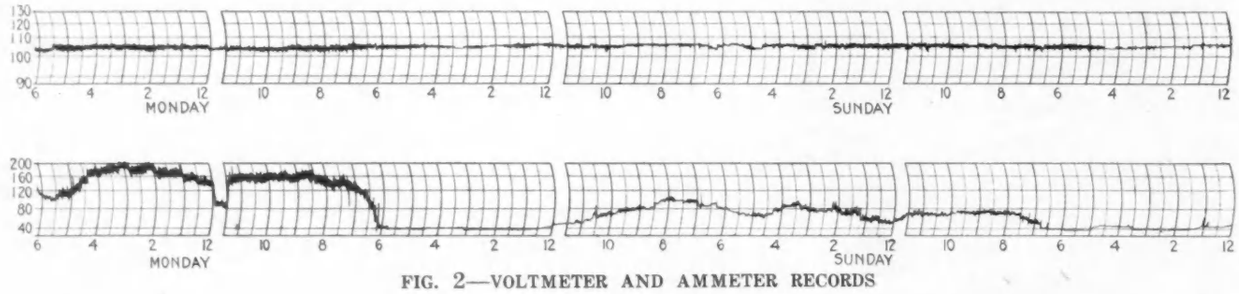


FIG. 2—VOLTMETER AND AMMETER RECORDS

regulators and accessories, as no provision had been made originally for such equipment.

The regulators and auxiliary apparatus described in this article were built by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

CURRENT NEWS SECTION

Conference on Concentric Wiring Rules

The special committee appointed at the meeting of electrical interests on Dec. 22 in the Biltmore Hotel, New York, to confer with the sub-committee of the National Fire Protection Association on rules regarding concentric wiring for interior work met with that committee in the rooms of the National Electric Light Association in New York on Jan. 1. Mr. W. H. Blood, Jr., of Boston, presided as chairman of the Underwriters' sub-committee having the matter in charge. Others in attendance included Messrs. G. S. Lawler, Washington Devereaux, J. C. Forsyth, A. M. Paddon, J. R. Strong and Dana Pierce, of the National Fire Protection Association's committee; R. K. Sheppard, C. E. Corrigan and H. B. Crouse, of the special committee appointed by the electrical interests, and R. S. Hale and H. R. Sargent, of the committee on the wiring of existing buildings appointed by the National Electric Light Association.

Mr. Sheppard presented the case of the electrical interests and dwelt at length on the various sides of the question at issue especially as brought out in the Biltmore Hotel meeting of the previous week. Both he and Mr. Crouse asked for delay in the promulgation of any rules which would permit the installation of concentric wires by inspection boards having jurisdiction as covered in the preamble of the proposed report of the sub-committee of the National Fire Protection Association. The Underwriters, on the other hand, felt that trial installations of the system would have to be made in order that the necessary field experience could be obtained, yet they were willing to meet the wishes of the manufacturers and contractors if the latter could suggest some other way in which the field experience could be acquired. The tentative rules, Mr. Blood said, were devised for the guidance of manufacturers and others who desired to delve into the matter, and while the use of concentric wire would enable the lighting companies to reduce the cost of wiring, the fact that such a wire possesses other features of merit besides cheapness, notably in that it permits a safer electrical installation, was sufficient reason for the Underwriters to look upon its use favorably. Mr. Pierce intimated that it would not be long before the "safety first" movement would compel more radical changes in wiring methods than that involved in the adoption of a concentric wiring system.

Mr. Sheppard and Mr. Crouse both brought out, in urging delay, that manufacturers have devoted their energies toward the improvement of systems already in use and that the inventive genius of the country is constrained to work along standard lines. It was suggested that if time were given this American inventive genius would doubtless produce something better than the Stannos wire or Kuhlos wire of Europe.

The Underwriters' committee thanked Mr. Sheppard and the members of his committee for their painstaking presentation of the matter and for the moderation of their requests. Tentative changes were made in the preamble of Mr. Blood's committee's report which met the approval of Mr. Sheppard's committee and it was agreed that differences of phraseology could be settled by correspondence. There was no doubt in the minds of any present as to the desirability of some less expensive wiring system than those at present in vogue; the question at issue had to do with the time when such systems would be indorsed by the Underwriters for universal use. All that the manufacturers desired was to have time given them to adjust themselves to any radical change. Mr. Crouse said that since the meeting of Dec. 22 many manufacturers have put their inventive forces to work on the problem.

Accident to Cleveland Municipal Plant

A break in a cable of the municipal electric-light plant at Cleveland made a large part of the West Side and South Side dark on the evening of Dec. 31. The break occurred in an overhead cable near the West Forty-first Street substation. Three hospitals, several theaters and a number of places where New Year's Eve celebrations were being held had no light and the streets in a large district were dark. Mr. F. W. Ballard, commissioner and chief engineer of the division of light and heat, denied a report that the cable had been cut, but said that the cause of the break was a mystery.

Serious Interruption to New York Subway Traffic

The longest interruption to subway traffic in the history of the Interborough Rapid Transit Company, New York City, occurred Jan. 6 during the morning rush hour following the burn-out of a number of cables supplying energy to the system. The cause of the burn-out has not been determined, but the following official statement was given to the press:

"About 8:10 o'clock this (Wednesday) morning a short-circuit was established on the cables in the manholes at Fifty-third Street. These manholes are on either side of the subway and the cables in them come from the substation in Fifty-third Street, east of Eighth Avenue.

"An examination of two manholes shows that practically all the cables have been short-circuited and destroyed. These short-circuits made a tremendous arc and created considerable gases and smoke from the burning insulation and the molten metal. The short-circuits automatically tripped circuit-breakers in the substation, which cut off the power. This automatically took the power away from the third-rail and the trains stopped."

As a result no trains could be moved in the section fed by these cables, tying up local and express trains running in both directions. As the cable burn-outs occurred in compartments opening into the tunnel soon after 8 a. m., when several hundred thousand persons were hurrying to business, the accident was of more than usual significance. Not only were these persons imprisoned in cars in the tunnel between stations and delayed in reaching their destinations, but several hundred were overcome by the suffocating fumes caused by the burning insulation and had to be removed through manholes and gratings in the street. About 200 were injured in the panic, but only one fatality was reported. Simultaneously with the task of transferring people to the street, attention was given by the Interborough company to restoration of service. Damaged cables were located and burn-outs or weakened sections

replaced. By 4 p. m. the system was repaired sufficiently to operate local trains. These, however, were not run at scheduled speed for fear of overtaxing the cables. Normal service was re-established by 2 a. m. Thursday morning.

The Engineering Foundation

On Jan. 25, in the auditorium of the Engineering Societies Building, New York, there will be held the inauguration of the "Engineering Foundation," which is the name given to a fund to be administered "for the advancement of the arts and sciences connected with engineering and the benefit of mankind," the basis of which is the initial gift of a considerable sum by a noted engineer for this purpose. The American Institute of Electrical Engineers, the American Society of Civil Engineers, the American Institute of Mining Engineers and the American Society of Mechanical Engineers are to be represented equally in the administrative board of the Engineering Foundation by election by the board of trustees of the United Engineering Society, which has been made the custodian of the fund. The inaugural ceremonies will be open to all members and friends of the engineering profession.

Electric Cars and Accessories at New York Automobile Show

The wider use of the battery for ignition, the practically universal adoption of electric starting and lighting, improvements in electric gear-shifting mechanisms and the introduction of electric transmission systems were features of electrical interest at the fifteenth annual National Automobile Show held in New York, Jan. 2-9. The total number of exhibits was 336, and, among the manufacturers of passenger vehicles represented, eighty-one were makers of gasoline cars and six of electric automobiles. There were also 236 exhibits of accessories and thirteen of motorcycles. The lowest price asked for a car was $295 and the highest $7,000.

The development of electric accessories for 1914, as evidenced by various devices shown, has been directed chiefly toward greater simplicity and wherever possible a reduction in weight. This has been particularly the case with magnetos. Among the starting apparatus there were a variable-speed compound-wound machine of improved type and several new devices for starting Ford cars. With lighting systems the lamps have been made simpler in appearance. Many devices were also shown for dimming the brilliance of headlamps.

Holding Company Must Keep Up Property

Judge Stewart filed an opinion in Easton, Pa., last week in the case of the Edison Illuminating Company versus the Eastern Pennsylvania Power Company and Pennsylvania Utilities Company. It appears that the Edison Illuminating Company leased its plant to the Easton Power Company on Feb. 1, 1900. The Easton Power Company was the predecessor in title of the present defendants. They were to pay $30,000 a year rental and to maintain the general efficiency of the plant. The Edison Illuminating Company admitted that it had received the rent each year, but alleged that the defendants had abandoned the plant and allowed it to deteriorate. The evidence was taken before the late Judge Stott and was that the plant had deteriorated at the time of the trial to the amount of $93,105.16. The defendants claimed that the Edison Illuminating Company had acquiesced in the changes and that there was too great delay in asserting its rights. Judge Stewart overruled these objections and directed that the defendant companies should restore the plant to the condition in which it was on Feb. 1, 1900, within six months from date, and directed that the defendant should pay the costs.

Dr. Humphreys Declares Commissions Extend Powers from Regulation to Control

Dr. A. C. Humphreys, president of the Stevens Institute of Technology, of Hoboken, N. J., made an address in connection with the 150th anniversary exercises of Brown University, Providence, R. I., on Jan. 4, in which he discussed commission regulation. He declared that the tendency of the Interstate Commerce Commission and of the state public utilities commissions has been to extend their powers from regulation to general control of business enterprises. While the commissions have instituted some much needed reforms, they have done much which has been unnecessarily injurious to the industrial and commercial life of the nation.

"One of the most apparent defects in the operation of commission control, state and federal," said Dr. Humphreys, "is the inability of the commissioners to master the technicalities involved in the grave and complex questions which, lawfully or unlawfully, are found in their hands for settlement. Questions of engineering and industrial management are involved in the great majority of these questions, while the personnel of the boards is made up generally of lawyers and theoretical economists conspicuously deficient in practical experience."

Progress in Federal Trade Commission Appointments

Some doubt is expressed in Washington as to the prospect that the Federal Trade Commission will begin its work soon. The situation has been complicated by a difference of opinion between the President and the Senate as to their respective rights in appointments. This and other conditions, notably the disinclination of Congress to pass the ship purchase bill, may bring about an extra session of Congress after the present session ends by statutory limitation on March 4.

Senator Cummins and others have given notice that the discussion of appointees will be prolonged and thorough. Notwithstanding the fact that Congress has been in session for a month, not one of the appropriation bills has been passed. On Jan. 5 the President hinted in his conference with newspaper men on duty at the White House that an extra session of Congress might be necessary.

It is understood that the President is not making the progress he would like in his selections for the commission. He would like to nominate Mr. George Foster Peabody, the New York banker, but Mr. Peabody has been averse to leaving his business.

Progressive senators and representatives, headed by Senators Clapp and Poindexter and Representatives Chandler of New York, Bryan and Falconer of Washington, and Kelly of Pennsylvania, have united on Mr. Hugh Gordon Miller, of Norfolk, Va., for a place on the commission, and are urging his candidacy. For the last eight years Mr. Miller has been a practising attorney of New York. He had been a republican but left the party with Colonel Roosevelt. Other Progressive senators and representatives are urging Mr. A. D. Nortoni, Progressive candidate for Governor of Missouri in 1912.

Senators Smith and Hardwick of Georgia are urging that the President appoint Mr. T. S. Felder, former

Attorney-General of Georgia. The President has him under consideration. The name of Mr. Edward N. Hurley, president of the Hurley Machine Company and of the Illinois Manufacturers' Association, is in favor with the President. His work as trade commissioner to the Latin-American republics received the high approval of the President.

Organization of the New Utilities Bureau

Trustees of the new Utilities Bureau held their first meeting at the University Club, Philadelphia, on Dec. 30. The following trustees were present: Messrs. Louis D. Brandeis, Frederick A. Cleveland, Samuel S. Fels, Charles F. Jenkins and Fred W. Taylor and Dr. Charles R. Van Hise.

Officers were elected as follows: President, Dr. Charles R. Van Hise, president of the University of Wisconsin; secretary, Dr. Clyde L. King, University of Pennsylvania; treasurer, Mr. Samuel S. Fels, manufacturer, of Philadelphia. Mr. Morris L. Cooke, director of public works of Philadelphia, was made acting director of the bureau.

The bureau has been established as an agency for municipalities in their dealings with public utility companies. It was started in connection with the conference of mayors, held in Philadelphia on Nov. 12 to 14, and reported in the ELECTRICAL WORLD of Nov. 21, 1914.

Testimony on Water-Power Bill

Abstracts of testimony on the water-power bill in addition to that mentioned in recent issues of the ELECTRICAL WORLD, given before the committee on public lands of the United States Senate, follow.

Mr. Gifford Pinchot

Mr. Pinchot, president of the National Conservation Association, declared that if water-power development has been checked in the United States the water-power interests are directly responsible. What the water-power men have been fighting for is to have the enormously valuable water-power grants given to them for ever and for nothing. They were willing enough to have the law changed for their benefit but refused to permit any corresponding concessions to the public. Rather than accept anything else than a free and perpetual gift of public property they have kept the present law in force. Of late years the principal efforts of the water-power interests have not been to develop water-power sites but to acquire and hold them undeveloped.

Mr. Pinchot expressed himself as being strongly impressed with the necessity for power development. He agreed that it would be very much better, if it were possible, to issue non-revocable permits, but said that nevertheless the permits in force now in national forests are such that the water-power development in these forests in 1914 was more than double what it was in 1913. In 1911 the ten greatest groups of water-power interests had developed and under construction 1,821,000 hp. In 1913 they had 2,711,000 hp, an increase of 890,000 hp. In 1911 the ten greatest interests held undeveloped 1,450,000 hp, which had risen to 3,500,000 hp in 1913, an increase of 2,050,000 hp in two years. These figures show that in the last two years the great power interests have increased their control of power held undeveloped more than twice as fast as they have increased their control of developed power. In 1908 the total developed water in the United States was 5,400,000 hp, and in 1913 it was 7,000,000 hp, an increase of about 33 per cent. In 1908 the thirteen greatest groups of interest controlled a total of 1,800,000 hp developed and undeveloped, while in 1913 a smaller number—ten—of the greatest groups controlled a total of 6,300,000 hp developed and undeveloped, an increase of 240 per cent. Thus concentration in ownership of water-power in the United States has increased in the last five years about seven times faster than power development. These figures were quoted by Mr. Pinchot to show that, instead of spending their money to develop the power sites they have, the great water-power interests have been spending money to acquire and hold power sites undeveloped to meet not a present but a future demand.

Mr. Pinchot suggested that the control of water-powers in the national forests be left in charge of the United States Forest Service.

Mr. Paul M. Lincoln

Mr. Lincoln, president of the American Institute of Electrical Engineers, filed the suggestions made by the public-policy committee of the Institute before the House committee in May, 1914. Mr. Lincoln called attention to the popular fallacy that the cost of water-power is usually very much less than the cost of competing power generated by steam. An engineer advised the installation of a steam plant in the city of Buffalo for the purpose of assisting the plant of the Niagara Falls Power Company. The latter plant was to take the best part of the load and the steam plant the daily peak load.

There is no question, Mr. Lincoln thought, that a combination of that kind can be worked out to make the total cost of power cheaper than the cost of power from the Niagara Falls Power Company. With Pennsylvania coal costing, as it does, about $2.50 a ton in Buffalo and the Buffalo load-factor as it is, power can be supplied from Niagara Falls cheaper than the cost of development by steam in Buffalo. The selling price of Niagara energy is approximately $20 per kw per year. The price per kilowatt-hour is considerably less than 1 cent and probably would come much closer to ¼ cent, but Mr. Lincoln could not give the exact figures.

Philadelphia Street-Lighting Contract Renewed

The contract between the city of Philadelphia and the Philadelphia Electric Company for arc street lighting during 1915 has been renewed at the rate which prevailed in 1914, about $89 per lamp per annum.

Mr. Joseph B. McCall, president of the company, said that the prices, terms and conditions are those named in the proposal made to the city by the company in June, 1914. The contract contains a clause that its execution shall not prevent either party from contending before the State Public Service Commission that the terms may be modified. If, on the presentation of the facts, the commission shall determine that any changes are essential, the changes authorized are to become effective as of Jan. 1, 1915. Mr. McCall said that, in accordance with the agreement made at the last hearing before the commission, an effort was made to reach an understanding with the city officials, but after several conferences it was impossible to agree upon mutually satisfactory terms.

Mayor Blankenburg of Philadelphia has written to Mr. Nathan T. Folwell, president of the Keystone Telephone Company, stating that investigations of the city indicate that under existing circumstances a city-owned and city-operated plant for street lighting affords not only the most economical method but will also insure efficient and satisfactory service. He quotes the decision of the Public Service Commission of Pennsylvania in

the case of the Gettysburg Light Company versus Gettysburg as removing any obstacles to full consideration of a municipal electric-lighting plant for Philadelphia. Mayor Blankenburg requested Mr. Folwell to appoint some person to discuss terms with the city for the use of the conduits. He asked for an option and declared that, barring the terms to be agreed upon for use of the conduits, the city's estimates are complete.

Upon request of the Philadelphia Electric Company, the Public Service Commission has postponed the adjourned hearing on city lighting rates in Philadelphia from Jan. 7 to Jan. 20.

Panama-Pacific Exposition Illumination Scheme Completed

The engineers and workmen who are installing the illumination system of the Panama-Pacific Exposition have virtually completed work on it. Nightly tests indicate that the success of this department of the Exposition work will meet all expectations of the engineers.

The lighting of the interior of Festival Hall, which is accomplished by the use of a deep light well beneath the floor of the building, has been tested, as has the illumination of the Palace of Horticulture. In Festival Hall a battery of searchlamps at the bottom of the light well sent up a flood of varicolored light, through a diffusing glass, which filled the huge dome with a soft radiance the source of which could not be seen. The task of hanging 100,000 jewels on the Tower of Jewels was completed Dec. 22.

Mr. W. D'A. Ryan, who was loaned to the Exposition, with a staff of illumination experts, to plan and install the illumination system, said that the lighting effects, so far as they had been tested, had not fallen short in a single detail.

The only salient feature of the system which yet awaits completion is the battery of forty-eight projectors, known as scintillators, installed on Morro Castle, on the west wall of the yacht harbor. These giant reflectors will be used in the creation of wonderful pyrotechnic effects on the clouds above the Exposition site, the fog banks rolling in through the Golden Gate and upon artificially created banks of steam.

Contest for Business in Northern Idaho

The long-expected power war that promises to involve northern Idaho and its great mining interests for an uncertain period was started before the Public Utilities Commission when the Washington Water Power Company, of Spokane, made application to that body for an injunction directed against the Montana Water Power Company, the Thompson Falls Power Company, the Federal Mining & Smelting Company and the Tamarack & Custer Consolidated Mining Company, to prevent the two named electrical companies from delivering electrical energy to the mining companies.

The application raises a new issue before the commission. All three of the electrical companies are nonresident corporations. Ever since electrical energy has been used to any extent in the mining regions of the Cœur d'Alene district and in the towns and cities there the Washington Water Power Company has furnished it and has had exclusive control of the territory.

The Montana Power Company negotiated for contracts with some of the larger mining companies. These companies are now customers of the Washington Water Power Company. As in previous cases, the commission has refused to permit competition in territory where another company had an investment and was giving satisfactory regulated service. The Montana Power Company, it is alleged, decided not to ask for the right to enter the northern Idaho mining field, but instead made arrangements with the Federal and Tamarack companies by which it built its transmission lines in Montana to the Idaho line. The mining companies built lines from their property to the boundary, and a connection will be made.

The Washington Water Power Company classes this as a conspiracy to rob it of valuable business and a subterfuge to enter Idaho without complying with the provisions of the public utilities act requiring a certificate of public convenience and necessity to be issued before construction by a public utility can be begun.

Spectacular Illumination of Woolworth Building

At midnight on Dec. 31 the new system of decorative lighting installed on the Woolworth Building in New York, the tallest office building in the world, received its initial trial. At 11 o'clock the first floor of the building was lighted, and every two minutes thereafter another floor flashed into light. Just at midnight, when the din attending the passing of the old year and the welcoming of the new was at its height, the light of the topmost pinnacle flared out. Seen from any angle the huge shaft made an imposing appearance. Specially designed reflectors are employed to direct the light against the structure so as to bring out all the beauty of its Gothic spires. Nitrogen-filled lamps are used throughout, and these are supplied with energy from the power plant in the basement.

WOOLWORTH BUILDING AT NIGHT

Miscellaneous News Notes

Time Off with Pay for Education.—The educational committee of the Edison Electric Illuminating Company of Boston is arranging details of plans whereby employees of the company will be allowed to devote a certain number of their regular office hours to studies which will benefit them in their work. No reduction in pay will be made for time thus occupied.

Large Wholesale Grocery Employs Battery Trucks in Building.—Austin, Nichols & Company, Brooklyn, N. Y., one of the largest wholesale grocery concerns in the world, is employing more than a dozen 4000-lb. storage battery trucks to transfer raw produce from lighterage or freight cars to the receiving department as well as to move crated goods about the building. Electricity is being supplied to this company by the Edison Electric Illuminating Company of Brooklyn.

Night Courses in Electricity.—The Washington University has announced two courses in electricity, commencing Jan. 18, to continue for eighteen weeks, and to cover the "principles of direct-current and alternating-current machinery" and "general electrical engineering practice." The courses will be open to students of more than eighteen years of age. The first course requires a knowledge of algebra, while the second course requires the applicant to have a general knowledge of arithmetic.

"White Way" for Hot Springs, Ark.—The Board of Aldermen of Hot Springs, Ark., has passed an ordinance authorizing the Board of Public Affairs to enter into a contract with the Citizens' Electric Company of that city for the purpose of lighting certain streets under the system known as the "white way." The contract will cover a period of ten years and provide for the erection by the electric-light company of 100 or more steel poles with four-lamp ornamental brackets and fifteen standards with one lamp. Each of the four-lamp clusters will burn from dusk until midnight, and one of the lamps will be kept burning from midnight until dawn. The lamp in the one-lamp fixture will burn from dusk until dawn. The company will receive $5 a month for lighting each of the four-lamp clusters and $2 a month for lighting each of the single-lamp standards, the lamps in each case being rated at 50 cp.

Use of the Telegraph in Great Britain.—The annual report of the Postmaster-General of Great Britain for the year ended March 31, 1914, records the number of telegraph offices as 14,152, and the number of telegrams transmitted as over 87,000,000. Improvements are being made with high-speed apparatus. The Gell perforator and the Creed reperforator and printer are being more extensively used; a new Siemens instrument is being tested, sextuple working has been applied to the Baudot apparatus between London and Birmingham, and quadruple duplex sets are to be installed between London and Liverpool and between London and Glasgow. A new form of Murray multiplex apparatus is also being worked experimentally between London and Manchester. The lines from London to the landing places of the French, Belgian, Dutch and German cables are now all underground.

Electric Shot-Firing Systems in Oklahoma Mining.—Secretary Lane of the Interior Department approved the recommendation of the Commissioner of Indian Affairs and the Director of the Bureau of Mines that the order of May 4, 1914, requiring the use of permissible explosives in the coal and asphalt mines on the segregated coal and asphalt lands belonging to the Choctaw and Chickasha Nations in Oklahoma or, in lieu thereof, the use of an electric shot-firing system operated from without the mine, should go into effect on Jan. 1, 1915. The Bureau of Mines conducted demonstrations in twelve typical coal-mining operations out of the forty-four coal mines on segregated lands, and made an exhaustive study of electric shot-firing systems. A liberal postponement will be allowed in individual cases so that no undue hardship will be imposed. The depressed financial condition makes it difficult for coal companies to raise any extensive amount of money at present in order to install mining machines. Electrical energy is not available at the present time to a considerable number of operators.

Associations and Societies

New York Section, I. E. S.—At the next meeting of the New York Section of the Illuminating Engineering Society, to be held Jan. 14, Mr. M. Luckiesh will present a paper entitled "The Application of the Tungsten Lamp to Photography," and Mr. R. F. Pierce will discuss gas lamps for photography. Mr. John B. Taylor, of the General Electric Company, Schenectady, N. Y., will give a demonstration of color photography. At a meeting to be held on Feb. 11 papers will be presented by Mr. W. H. Rolinson on "The Gas-Filled Lamp for Street Lighting," and by Mr. C. A. B. Halvorson, Jr., on "The Magnetite Lamp for Street Lighting."

New York Electrical Society.—On Wednesday, Jan. 13, Mr. William A. Blonck will deliver a lecture before the New York Electrical Society on "European Boiler Room Practice and Boiler Efficiency Methods in the United States, with Reference to Electric Light and Power Plants." Mr. Blonck will discuss the construction and performance of high-duty boilers, as used in electric plants of Europe. He will also take up the practical question of the more rational and economical use of coal in the boiler rooms of electric power plants by means of definite indications of the combustion process which are simple and comprehensible to the firemen, so that guesswork and waste shall be entirely eliminated.

The Cottrell Dinner.—The American Institute of Mining Engineers, the American Electrochemical Society and the Mining and Metallurgical Society of America will give a complimentary dinner on Friday, Jan. 15, at the Hotel Plaza to Dr. Frederick Gardner Cottrell, of the Bureau of Mines, in recognition of his contributions to research. It is well known that Dr. Cottrell assigned the patents for his process of electrostatic precipitation of fumes to the Research Corporation, the receipts from licenses to be used for the furtherance of research. As a result of this gift the Research Corporation is now in a flourishing condition. The speakers at the dinner will be Mr. W. L. Saunders for the American Institute of Mining Engineers, Mr. Walter R. Ingalls for the Mining and Metallurgical Society of America, and Mr. F. A. Lidbury for the American Electrochemical Society.

Electric Trucks in Winter Time.—"Operating Electric Trucks Under Winter Conditions" was the subject of discussion at the monthly meeting of the New York Section of the Electric Vehicle Association of America on Dec. 30. The need of preparation before inclement winter weather sets in and the importance of properly educating the operators and garage men as to the problems peculiar to winter time were emphasized by all the speakers. Mr. F. N. Carle told of the efforts of central stations and manufacturers in New York City to warn the owners of electrical vehicles beforehand of unusually severe operating conditions that are likely to take place in winter time. Mr. E. A. Graham spoke of cold-weather operating conditions in Winnipeg, Canada, and how the electric truck was able to hold its own with the gasoline car, and in some respects even to surpass it. Mr. W. A. Donkin, chairman of the Pittsburgh Section, stated that on account of the hills in Pittsburgh skid devices are used throughout the year and that during severe snowstorms the electric truck gives exceptionally good service.

Western Association of Electrical Inspectors.—The tenth national convention of the Western Association of Electrical Inspectors will be held at the Hotel Radisson, Minneapolis, Minn., Jan. 26 to 28. The sessions will be opened Tuesday morning with an address of welcome by Mayor Nye of Minneapolis. Mr. Waldemar Michaelson, former city electrician of Omaha, Neb., is scheduled to respond. At the afternoon session the following papers will be presented: "Elevator Motor Controllers," Mr. J. H. Miller, general superintendent Otis Elevator Company, Chicago; "Fire-Alarm Systems," Mr. Frank F. Stover, Star Electric Company, Binghamton, N. Y. Reports from the committee on induction motors, Mr. K. W. Adkins chairman, and the committee on signal systems, Mr. J. R. Morrisey chairman, will be presented. On Wednesday morning the program will be: Report of committee on underground systems,

Mr. Guy W. See chairman; address, "Electric, Steam and Water Power in a Modern Flour Mill," Mr. Charles A. Lang, superintendent Northwestern Consolidated Milling Company, Minneapolis; report of committee on electric traction systems, Mr. Frank R. Daniel chairman; address, "Electrolysis, Its Detection and Mitigation," Mr. Burton McCullom, electrical engineer Bureau of Standards, Washington, D. C. Thursday morning: Report of committee on laws and ordinances, Mr. W. S. Boyd, Chicago, chairman; address, "Approved Fittings and the Label Service," Mr. J. E. Latta, Underwriters' Laboratories, Chicago; report of committee on the National Electrical Code, Mr. F. D. Varnam chairman; address, "How to Deal with the Public," Mr. John S. Taylor. Thursday afternoon: Report of committee on rubber-covered wire, Mr. Victor H. Tousley chairman; address, "The Manufacture of Rubber-Covered Wire," Mr. Everett Morse, engineer Simplex Wire & Cable Company, Boston, Mass. The association banquet will be held on Wednesday evening with Mr. W. I. Gray as toastmaster. On Thursday evening the association will hold a joint dinner with the Minnesota Section, A. I. E. E., after which Mr. Charles L. Pillsbury, consulting engineer, Minneapolis, will speak on "Principles Entering into the Valuation of Public Utilities and Rate Making." In celebration of this, the tenth or "tin wedding" meeting of the association, a special invitation to attend has been extended to the wives of members, and the local entertainment committee, Mr. Emil Anderson chairman, has provided an elaborate entertainment program for both members and guests. Mr. Ben W. Clark, Detroit, Mich., is president of the association, and Mr. William S. Boyd, 175 West Jackson Boulevard, Chicago, is secretary.

Wisconsin Electrical Association.—The Wisconsin Electrical Association will hold a joint convention with the Wisconsin Gas Association at Milwaukee Jan. 20 to 22. The sessions of Jan. 20 will be devoted to gas topics, those of Jan. 21 to subjects of common interest to both the gas and electric-lighting industries, and those of Jan. 22 to topics of interest to electric-railway and electric-utility men. A paper on "The Wisconsin Railroad Commission's Method of Rate Making" is listed on the advance program, and there will be other papers on the subjects of financing utility properties, operation, office efficiency and public-service corporation regulation. Mr. P. H. Korst, Janesville, Wis., is president, and Mr. George Allison, Stephenson Building, Milwaukee, Wis., is secretary-treasurer. Following is the program for the electrical sessions: Thursday, Jan. 21, morning: "Financing of Public Utility Properties," by Mr. Andrew Cooke, consulting financial expert, Chicago, formerly vice-president Harris Trust & Savings Bank, Chicago; "The Continuous Meter-Reading and Discount System," by Mr. F. J. Maxwell, auditor Eastern Wisconsin Railway & Light Company, Fond du Lac, Wis.; "Advertising Influence of Public Service Employees," by Mr. R. O. Jasperson, advertising agent Milwaukee Gas Light Company. Afternoon: "The Wisconsin Railroad Commission's Method of Rate Making," by a member of the Wisconsin Railroad Commission, Madison, Wis.; "Practical Effect of the Workmen's Compensation Act," by Mr. Carl Muskat, attorney, Milwaukee; "Increased Taxation in Wisconsin and Its Effect on Public Service Companies," by Mr. Edwin Gruhl, Watertown Gas & Electric Company, Watertown, Wis. Friday, Jan. 22, morning: "One-Man Electric Car Operation in a Small City," by Mr. R. M. Howard, general manager Minnesota Division Wisconsin Railway, Light & Power Company, Winona, Wis.; "Latent Water-Powers and Difficulties of Development Under the New Wisconsin Water-Power Law," by Mr. Daniel W. Mead, Madison, Wis.; "Latest Tendencies and Developments in Street Lighting and Incandescent Lamps," by Mr. S. L. E. Rose, General Electric Company, Schenectady, N. Y. Afternoon: "How to Overcome Some Operating Difficulties of Small Utilities," by Messrs. J. N. Cadby and C. B. Hayden, electrical engineers Railroad Commission of Wisconsin, Madison; "Experience and Suggestions for the New-Business Departments of a Small Electric Utility," by Mr. C. M. Axford, commercial department Wisconsin Public Service Company, Green Bay, Wis.; "Practical Suggestions for Increasing the Efficiency of Small Steam-Electric Plants," by Mr. William F. Lathrop, of the Wisconsin Gas & Electric Company, of Racine, Wis.

Public Service Commission News

New York Commissions

Plans of Governor Whitman and the Republican party for an investigation and reorganization of the New York Public Service Commissions have been brought to a head by the fire in the subway on Jan. 6. After conferences with the leaders in the Legislature Governor Whitman stated that he expected to see definite steps taken to start an inquiry preliminary to a general reconstruction of the commissions within a short time. The general plan now under discussion is to have an investigation made by a committee of the Legislature. In case action is not taken by the Legislature and a committee, it is stated that the Governor will act independently under the Moreland law and appoint a commissioner himself to make an investigation.

A resolution was offered in the Senate on Jan. 6 by Senator William M. Bennett, providing for an investigation of the fire in the subway as well as of the two commissions. It provides for the appointment of five members of the Assembly by the Speaker and three Senators by the Lieutenant-Governor. An appropriation of $25,000 is made. The immediate adoption of the resolution was urged by Senator Bennett, but as a general agreement had been made that the Senate should do nothing more than organize and receive the Governor's message on the opening day, the resolution was laid on the table.

The Second District commission has adopted the first changes in its rules of procedure since its organization in 1907, designed to provide for the new functions imposed on the commission by the Legislature when such activities as those of the telegraph and telephone companies, autobus lines, the steam corporations and the baggage transfer companies were put under its jurisdiction.

Ohio Commission

In its annual report, made to Governor Cox on Dec. 31, the commission suggested that railroads and public utilities should be required to notify the commission immediately of any change in the personnel of their responsible officers. It was suggested that a law be enacted authorizing the commission to order the refund of illegal or unreasonable charges by railroads or utilities. The members also wish to be exempt from testifying in civil cases that grow out of matters that have been investigated officially.

The report states that the commission has initiated many physical valuations at the request of city councils. In most instances, the report assumes, these valuations were desired in rate-making. The new uniform classification of accounts went into effect on Jan. 1.

The commission desires power to suspend rates or schedules pending investigations. Under the present law it cannot initiate investigations of such rates or schedules until they have gone into effect. It asks that utilities be required to give thirty days' notice of changes made in rates or schedules.

The Youngstown & Sharon Street Railway Company has secured permission to intervene in the case of the Mahoning Light & Power Company, which was granted permission recently to purchase a small private company in Youngstown and issue securities. When the order is ready to be issued, the company will enter objections and ask for a rehearing. Failing in this, it will carry the case to the State Supreme Court. It bases its objections on the ground that its service is satisfactory and sufficient for the territory served.

New Jersey Commission

The Board of Public Utility Commissioners has dismissed the complaint of Mr. J. F. Davison against the Lakewood Water, Light & Power Company, based upon his refusal to permit the company to test his water meter and a subsequent refusal of the company to render service. The board holds that it is not only a right but a duty of a company to seal all meters and to examine and test them whenever necessary. Referring to the contention that a charge for the meter made it the property of the consumer, the board says that the actual ownership of the meter does not affect the company's control over it, the fact that a patron is required to pay for the meter being one affecting only the rates charged for service and not the company's control.

The following committee of the Legislature has been appointed to study the rate-making powers of the Board of Public Utility Commissioners: Senators Rathbun, Gaunt and Hutchinson and Assemblymen Runyon, Randall, Wolverton, Barrendale and Stevens.

Michigan Commission

The Railroad Commission has ordered the appraisal of the property of the electric light and power companies controlled by the Commonwealth Power Company interests. The appraisal will be made by Prof. M. E. Cooley, of the University of Michigan, and his assistants. The appraisal is made in connection with the application of the Consumers' Power Company of Maine to be admitted to Michigan.

Pennsylvania Commission

Gas and electric light and power companies have been notified by the commission that when a company names a period in which a discount will be allowed on bills the discount period must be observed rigidly, and all bills not paid by the expiration of the last discount day must be paid in full.

Idaho Commission

Retention of the Public Utilities Commission as a means of offsetting federal control of Idaho's resources is advocated by Senator Borah in a letter just received from him by Mr. C. F. Koelsch, Representative-elect from Ada County. Senator Borah points to pending national legislation and shows why a public utilities commission will be necessary for the State if such legislation is to be passed in order that the State may combat a radical conservation policy. His letter says:

"I am much opposed to the leasing system covering, as it is now intended to do, all of our natural resources, not only because in my judgment it will retard the development of the State, withholding from taxation a vast amount of property which ought to be taxed, but because the royalties which will be collected will ultimately be passed over and charged up to the citizens of the State and will constitute in the final effect a new tax and a new burden laid specially and alone upon the public land states. But I am of the opinion that such a system is going to be tried and that these bills will be ultimately passed, and I feel quite certain that we will find a public utilities law and an efficient public utilities commission of very great service to us under such circumstances.

"There is another feature of the controversy, and that is as to the legal right of the national government to fix rates to be charged for power where the power is used wholly within the State. I do not believe it can attach to the leasing of its public lands any provision which will take away from the State its right to regulate and control its domestic affairs. But one thing is quite certain, that unless we had some means and some method by which to test the question we should not be in a position to challenge the authority of the national government. Moreover, I believe the State would not want these public service corporations to go without any regulation and control whatever, and unless we had an efficient public utilities law they would prefer federal regulation rather than no regulation at all."

An answer has been filed with the Public Utilities Commission to the complaint of the Attorney-General against the Idaho-Oregon Light & Power Company. In his complaint the Attorney-General asserted that the company was discriminating in rates, and that it was not following the schedules filed with the commission. These charges are denied by Mr. W. J. Ferris, receiver for the company, who explains that the company is furnishing energy in accordance with certain special contracts and oral agreements outside its regular rates, but says that not only are all these contracts on file with the commission, but that they show no unreasonable difference in rates and no failure to observe the rules of the commission.

Missouri Commission

On application of the Springfield (Mo.) Gas & Electric Company the United States District Court for the Western District of Missouri has granted a preliminary injunction restraining the Public Service Commission of Missouri from enforcing the order recently made by it reducing electrical rates.

Personal

Mr. Howard A. Huey has been appointed assistant manager of the Oklahoma Gas & Electric Company, Oklahoma City, Okla.

Mr. I. M. Stover has been appointed manager of the Key West (Fla.) Electric Company as successor to Mr. B. L. Grooms, who has been transferred to Savannah.

Mr. J. Harry Pieper, assistant general agent of the Southern California Edison Company, Los Angeles, Cal., has been elected president of the Los Angeles Advertising Club.

Mr. Peter J. Beisel has been appointed city electrician of Allentown, Pa. He will have supervision over the fire and police call systems and all other electrical activities entered into by the city.

Mr. Timothy C. O'Hearn, for the past eleven years city electrician of Cambridge, Mass., has sent in his resignation to Mayor Good, to take effect April 1, 1915. He is an instructor at the Massachusetts Institute of Technology.

Mr. B. L. Grooms, recently manager of the Key West (Fla.) Electric Company and for some years chief inspector of the Savannah (Ga.) Electric Company, has been transferred to Savannah, where he will become superintendent of transportation of the company.

Ex-Gov. Samuel W. Pennypacker, a member of the Public Service Commission of Pennsylvania, has been appointed chairman of that body to fill the uncompleted term of the late Nathaniel Ewing. By this action the term of each of the commissioners is advanced one year.

Mr. J. S. Hendrie, for some time a member of the Hydro-Electric Power Commission of Ontario, and at present Lieutenant-Governor of the Province of Ontario, has been elected a director of the Canadian General Electric Company, succeeding the late Senator Jaffray.

Mr. Thomas T. Logie, for the past three years manager of the Westfield (Mass.) municipal lighting department, has resigned to enter private business. Mr. Logie was formerly assistant superintendent of the South Norwalk (Conn.) division of the United Electric Light & Water Company.

Mr. J. D. Ross has been reappointed superintendent of the Seattle City Lighting Department by Mayor Gill for three years at a salary of $5,000. In reappointing Mr. Ross the Mayor referred to him as an indefatigable worker and a man of ability. The best proof of his merit, he said, was the fact that Mr. Ross has managed the municipal plant successfully in spite of many obstacles and against strenuous opposition.

Mr. Walter H. Gaither, of Pittsburgh, Pa., has been appointed a member of the Public Service Commission of Pennsylvania by Governor Tener for a term of two and one-half years, beginning on Jan. 19, 1915. The newly appointed commissioner was born in Foxburg, Clarion County, Pa., forty-five years ago, and was engaged in newspaper work in Pittsburgh for several years. He was secretary to Governor Tener during his term as Congressman, and has served in the same capacity since Mr. Tener became Governor.

Mr. Thomas P. Riley, judge of the Malden (Mass.) District Court, has been appointed a member of the Massachusetts Gas and Electric Light Commission to fill the vacancy created by the advancement of Mr. Alonzo R. Weed to the chairmanship, following the death of the late chairman, Forrest E. Barker. The new nominee was born at Medford, Mass., in 1875, and after being educated at Boston Univeristy Law School was admitted to the Massachusetts bar in 1901. He has served a number of terms in the Legislature and was appointed associate judge of the Malden Court in 1911. For two years he was chairman of the Democratic State Committee and served as Assistant Attorney-General of Massachusetts until the expiration of the recent term.

Mr. T. C. Martin, secretary of the National Electric Light Association, will proceed from New York on Jan. 14 to San Francisco to confer with the committees there and help consummate the local arrangements for the next annual convention, to be held there during the first week in June. Other points on the Pacific Coast will also be visited in

this connection. Mr. Martin is also to give attention to company section work in the cities passed through on his return route. He will be accompanied to San Francisco by Mr. George W. Elliott, master of transportation, who is now organizing four special tours to the convention, and has to settle many points in regard to them at the other end of the line. They will be engaged on this work until early in February.

Mr. Philip E. Hart, mechanical and electrical engineer and associate member of the American Institute of Electrical Engineers, is now in England and expects to leave for the front shortly, having received orders to join his regiment (artillery), in which he has received a commission. Mr. Hart received his training at the London University and joined the testing department of the General Electric Company in Schenectady. He has been connected with the West Kootenay Power & Light Company, Rossland, B. C.; the Allis-Chalmers-Bullock Company, the Pacific Gas & Electric Company, and the Dorada Railway (ropeway extension), Colombia, South America. Mr. Hart was acting as resident engineer for this last company when war broke out. He left for England in October.

Mr. Rodolfo Roth, formerly manager of the machinery business of Buxton, Cassini & Company, of Buenos Aires, Argentina, and now a consulting engineer in that city and a professor in the National University of La Plata and secretary of the Argentine Association of Electrical Engineers, is spending a few weeks in the United States making a special investigation for the Argentine National Board of Sanitary Works. At the same time he is studying matters connected with the business relations existing between the United States and Argentina. Mr. Roth was graduated from Cornell University some years ago in the course in electrical engineering, and at about the middle of the course he went into business for about three years in Mexico. He was an engineer with Braschi & Company in Mexico City and assistant manager of the Aguas Calientes Electric Light & Power Company of Mexico. In Argentina he has also been superintendent of the Compañia General de Illuminacion y Ornato. He expects to return to Argentina in February.

Mr. John J. Gibson has been appointed manager of the detail and supply department of the Westinghouse Electric & Manufacturing Company at East Pittsburgh, to succeed Mr. G. B. Griffin. Mr. Gibson was born in York, Pa., and after attending the Collegiate Institute at that place entered Lehigh University at Bethlehem, Pa. After graduation he entered the employ of the Westinghouse Electric & Manufacturing Company and was engaged in work on meters, arc lamps and switchboards. From 1896 to 1900 Mr. Gibson was employed by the American Telephone & Telegraph Company as inspector, and later as district manager at Norfolk, Va. In 1900 he re-entered the employ of the Westinghouse company as chief correspondent of the Chicago office, and later as salesman in the same office. Mr. Gibson was transferred in 1905 to the Philadelphia sales office, in which capacity he remained until his appointment as district manager in 1906.

J. J. GIBSON

Mr. Joseph B. Eastman, of Boston, has been appointed a member of the Massachusetts Public Service Commission, succeeding Mr. George W. Anderson, resigned. Mr. Eastman has been secretary of the Public Franchise League of Boston since 1905. He was born in 1882 at Katonah, N. Y., and was graduated from Amherst College in 1904, when he received a fellowship which permitted him to study social and political conditions for a time at the South End House, Boston. After becoming associated with the Public Franchise League, Mr. Eastman handled the rate petition of that body relative to the Edison Electric Illuminating Company of Boston before the Gas and Electric Light Commission about five years ago and was active in regard to the adoption of the sliding scale of rates by gas companies, besides appearing upon other matters. In 1912 he helped draft the bill which became the public utilities act of 1913, and he has given much time to work as counsel for labor organizations in the electric railway and lighting fields.

Mr. H. W. Cope, formerly assistant manager of the industrial and power department at East Pittsburgh, has been appointed director of the Westinghouse Electric & Manufacturing Company's exhibit for the Panama-Pacific International Exposition, and is now stationed in San Francisco. Mr. Cope was born in North Vernon, Ind., and is a graduate of Purdue University. Prior to his attending the university he was engaged in electrical construction and sales work. In September, 1898, following his graduation, he became associated with the Westinghouse Electric & Manufacturing Company at East Pittsburgh, with which company he has remained ever since. Mr. Cope took the apprenticeship course and was engaged in the engineering department in connection with the design of alternating-current switchboards, the layout of power houses and substations, and in 1905 he was made the head of the alternating-current correspondence department. A short time after this he was made assistant manager of the industrial and power department.

H. W. COPE

Mr. G. Brewer Griffin, formerly manager of the detail and supply department of the Westinghouse Electric & Manufacturing Company, has been appointed manager of the automobile equipment department. Mr. Griffin has been connected with the electrical business for some years, having started in 1889 with the Thomson-Houston Company, at Lynn, with which company he remained until 1894, when he became associated with the Narragansett Electric Company at Providence, R. I. While with this company he aided in entirely rebuilding and rearranging its distributing system. In 1896 he went to Elmira, N. Y., and became manager of the jobbing and contracting and new-business departments of the Municipal Improvement Company, which was engaged in a general construction supply business in connection with the water, street-railway and electric-light plants. In 1900 Mr. Griffin became connected with the Manhattan General Construction Company of New York as special representative, opening an office in Boston as New England manager one year later, which position he held until the company was absorbed by the Westinghouse Electric & Manufacturing Company. In 1902 he went to East Pittsburgh as assistant manager of the retail and supply department, succeeding to the position of manager in 1909.

G. B. GRIFFIN

Obituary

John Henry Clark, for many years connected with the power and mining sales department of the General Electric Company at Schenectady, N. Y., died Jan. 3. Mr. Clark was born in Cornwall, England, in 1859. He became connected with the Thomson-Houston Company in 1890, and with the General Electric Company when that company took over the former company a few years later. He was a member of the American Society of Mechanical Engineers, the Boston Engineers' Club and the Engineers' Club of New York.

Corporate and Financial

Corning Light & Power Initial Dividend.—The Corning (N. Y.) Light & Power Corporation has declared an initial dividend of 1 per cent on the $375,000 stock.

Midland Counties Public Service to Renew Notes.—The Railroad Commission of California has authorized the Midland Counties Public Service Corporation to renew $24,796 notes.

Philadelphia Electric Company Election.—Mr. Sidney F. Tyler has been elected a director of the Philadelphia Electric Company to fill the vacancy caused by the death of Thomas Dolan.

Portsmouth Street Railroad & Light Company's First Mortgage Bonds.—Baker, Ayling & Company, of Boston, are offering $500,000 of 6 per cent first mortgage gold bonds of the Portsmouth Street Railroad & Light Company.

Listings on New York Exchange in 1914.—According to the *Wall Street Journal*, $20,913,000 of 5 per cent electric utility bonds and $42,267,600 of stock, a total of $63,180,600, were listed on the New York Stock Exchange during 1914.

Western States Gas & Electric to Issue Bonds in Lieu of Notes.—The Western States Gas & Electric Company has been authorized by the California Railroad Commission to issue $101,000 of 5 per cent bonds at not less than 82½ and interest in lieu of $142,700 of the three-year 6 per cent notes previously authorized.

Great Western Power to Renew Notes.—The Railroad Commission of California has issued a supplemental order authorizing the Great Western Power Company to renew a note for $150,000 in favor of the Old Colony Trust Company of Boston. This note is secured by a pledge of $225,000 of first mortgage bonds.

Rodeo Land & Water Company Properties to Be Sold.—The Rodeo Land & Water Company has been authorized by the California Commission to sell its water, gas and electric systems to the Beverly Hills Utilities Company of Los Angeles, which is authorized to issue 100 shares of capital stock at par in payment for the property.

Electrical Securities Corporation Bond Offering.—Jackson & Curtis, of New York and Boston, are offering at 98 and interest $500,000 collateral-trust sinking fund gold 5 per cent bonds of the Electrical Securities Corporation, due Feb. 1, 1943. The common stock of the company is owned by the General Electric Company, of Schenectady, N. Y.

Dayton Power & Light to Purchase Cedarville Plant.—The Dayton (Ohio) Power & Light Company has been granted authority to purchase the plant and business of the Cedarville (Ohio) Light & Power Company for $20,000. The Cedarville company has a water-power plant at Clifton, Ohio, and a steam plant at Cedarville. These will be operated in conjunction with the Dayton company's plant.

Empire Gas & Electric to Purchase Weedsport Company.—The Empire Gas & Electric Company, Auburn, N. Y., has been authorized by the New York Public Service Commission, Second District, to purchase the $15,000 stock of the Weedsport (N. Y.) Electric Light Company for not more than $19,000. The order provides that the Empire company must amortize the stock at the rate of $500 for 1915 and $1,000 for each succeeding year until it is carried on the books in 1920 at $13,500.

Alabama Traction, Light & Power Option.—Holders of certificates of option to purchase at $15 shares of the Alabama Traction, Light & Power Company were given the privilege to extend the option from Dec. 31, 1914, to Dec. 31, 1915, on the payment of 10 shillings per share. As an alternative, the holder may extend the option until twelve months after the conclusion of peace, or on the expiration of the court's acts of 1914, whichever is sooner, by the payment of £2 per share.

Montpelier & Barre Light & Power Capital Increase.—The Montpelier & Barre Light & Power Company of Boston, Mass., has increased its authorized capital stock from $2,131,000 to $4,810,000. Mr. A. B. Tenney, president of the company, writes that this issue is necessary owing to the conversion privilege in an issue of $2,500,000 convertible bonds authorized. The bonds are issued for funding and refunding outstanding indebtedness and to provide for extensions and future needs under conservative restrictions.

Associated Gas & Electric to Acquire More Stock of Subsidiaries.—The New York Public Service Commission, Second District, has authorized the Associated Gas & Electric Company to buy at par $22,400 stock of the Homer & Cortland Gas Light Company to be issued under the authority of an order of the commission granted in August, 1913, and also to acquire $36,600 outstanding stock of the Norwich Gas & Electric Company and $33,400 additional stock of the Norwich company to be issued under an order of the commission dated Dec. 9, 1914.

New York Receiver for International Power.—Upon application of Mr. George W. Hoadley, Supreme Court Justice Hendrick appointed Mr. Charles H. Ridder receiver of the International Power Company. The action was taken to prevent Mr. Sadler, the New Jersey receiver, from removing the assets of the company from New York to New Jersey. The suit was brought in behalf of a subsidiary company, the American & British Manufacturing Company, of Bridgeport, Conn., of which Mr. Hoadley is president, which company claims that $100,000 is due it for loans to the International Power Company and moneys paid out at its request.

San Joaquin Light & Power to Acquire Other Properties.—The Selma Water Works, Madera Water Works, Madera Light & Power Company, Lemoore Light & Power Corporation and Bakersfield Gas & Electric Light Company have been authorized by the California Railroad Commission to transfer their properties to the San Joaquin Light & Power Corporation. The San Joaquin company is to cancel all of the capital stock of the companies with the exception of the Bakersfield Gas & Electric Company. This company has an outstanding bond issue and, with the exception of sufficient shares to qualify directors, all of its stock will be canceled.

Boston Edison Company Prosperous.—New business contracted for during the calendar year 1914 by the Edison Electric Illuminating Company of Boston, Mass., exceeded all previous records and surpassed that booked in 1913 by 25 per cent. The output for the week ended Christmas Day was 7 per cent ahead of the corresponding week a year ago, the peak load of the year being 65,342 kw, compared with 63,131 kw last year, a gain of 3.5 per cent. The largest daily output in the company's history was on Dec. 21, when 777,000 kw-hr. was generated. Little evidence of retrenchment in the use of electricity for lighting and motor service appears in the 700 square miles of the company's territory.

New Company Formed in Maine.—The Maine Railways, Light & Power Company, which was formed in Maine in June, 1914, owns 86 per cent of the outstanding shares of the Rockland, Thomaston & Camden Street Railway and the entire stock of the Norway & Paris Street Railway. In addition, it operates two miles of electric road connecting the towns of Norway and Paris, owns and operates a gas plant in the city of Rockland and furnishes electric service in Rockland, Camden, Rockport, Warren, Norway and Paris. The company has a long-term contract with the Central Maine Power Company for hydroelectric energy. The directors of the company are Messrs. W. T. Cobb, R. C. Bradford, H. J. Chisolm, E. W. Cox, C. G. Allen, W. Pettengill, E. W. Clark, A. L. Bird, M. S. Bird, and S. B. Larrabee.

Hodenpyl, Hardy & Company Incorporated.—Hodenpyl, Hardy & Company, of New York, have been incorporated with a capitalization of $2,000,000 to manage public utilities and do a stock and bond business. There will be no change in policy or practice from the old partnership firm. The new company will continue the management of the controlled properties and the financing of the same. The principal property managed by the company is the Commonwealth Power, Railway & Light Company, which serves communities in Michigan, Illinois, Indiana, Ohio and Wisconsin. This property is operated jointly with E. W. Clarke & Company. The officers of the company are: Messrs. A. G. Hodenpyl, presdent; G. E. Hardy, B. C. Cobb, J. C. Weadock, W. S. Barthold and A. H. Johnson, vice-presidents, and Jacob Heckma, secretary and treasurer.

Manufacturing and Industrial

The Condensite Company of America has moved from Glen Ridge, N. J., to Bloomfield, N. J.

Balcom & Darrow, engineers, have moved their offices to 10 East Forty-seventh Street, New York.

The New York Insulated Wire Company, 114 Liberty Street, New York, has appointed Mr. L. O. Brewster general manager.

The American Manufacturers' Agency, 111 Monroe Street. Chicago, Ill., has taken the agency for the Novelty Incandescent Lamp Company, of Emporium, Pa.

The Multi-Lux Company, 6712 Union Avenue, Cleveland, Ohio, is the name of the concern formerly known as Pease & Smith and before the adoption of that name as the Multi-Lux Illuminating Company.

The Partrick & Wilkins Company, 51 North Seventh Street, Philadelphia, Pa., has purchased all the assets of the Partrick, Carter & Wilkins Company, formerly manufacturers of needle annunciators and electrical house goods.

The Bearings Company of America, 250 West Fifty-fourth Street, New York City, is the successor to J. S. Bretz Company, New York, Fitchel & Sachs, Lancaster, Pa., and the Star Ball Retainer Company, Lancaster, Pa.

The Electrical Alloy Company, Morristown, N. J., has opened an office at 180 North Dearborn Street, Chicago, Ill., which is in charge of L. L. Fleig & Company, who have been appointed the Western representatives of the company.

The Wagner Electric Manufacturing Company, St. Louis, Mo., has opened a sales office in the Pioneer Building, St. Paul, Minn., which is in charge of Mr. C. K. Hillman, who for some time has been identified with the sales of Wagner apparatus in this territory.

Condition of Flashlamp Company in England Normal.—According to Mr. F. F. Phillips, export manager of the American Ever-Ready Works, 304 Hudson Street, New York, the concern's establishment in London is operating normally and is in a position adequately to supply the needs of the English market.

The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has organized a separate department for the production and sale of automobile accessories, to be known as the automobile equipment department. Mr. G. B. Griffin, formerly manager of the company's detail and supply department, is manager of the new department.

Off Season for Decorative Chains.—The Owen Walsh Manufacturing Company, 525 West Twenty-sixth Street, New York, maker of decorative chains and lighting fixtures, is noting a decrease in the demand for its products, which it is declared will continue throughout January, as this month and June are off months for the business.

Business in Wiring Devices Slow.—On account of the curtailment in building operations there is not a great demand for wiring devices. According to one manufacturer there is no immediate prospect of an improvement, and even though the building business should pick up, it will be some time before the buildings reach the state of completion where such material would be required.

No Complaint to Make.—Mr. A. L. Eustice, treasurer of the Economy Fuse & Manufacturing Company, Chicago, Ill., wrote to the ELECTRICAL WORLD that his company had no cause for complaint regarding the amount of business which had been secured during the last year. In general, he declared, the Economy Fuse & Manufacturing Company is expecting a decided improvement in the business situation.

Nothing Wrong with Business Conditions.—Fundamentally there is nothing wrong with business conditions, Mr. L. L. Brastow of the Trumbull Electric Manufacturing Company, Plainville, Conn., asserted in a recent letter to the ELECTRICAL WORLD. "When things do start," he remarked, "they will start heavily. We certainly believe that the coming year will be a better business year than the one just closed. Still, we do not think it will be so good as the year 1913, although we hope so."

Steel Boxes Selling Well.—According to Mr. F. X. Cleary, of the Electric Operations Company, Bush Terminal, Brooklyn, N. Y., there is quite a demand for his company's steel boxes. Among recent purchasers are the following: L. K. Comstock & Company for the Rosenbaum Building in Pittsburgh, Pa., and the Albany (N. Y.) Main Telephone Building; the Western Electric Company, the Sprague Electric Works of the General Electric Company, the Safety Car Heating & Lighting Company, Elliot Lewis, Philadelphia, and the H. I. Sackett Electric Company, Buffalo.

The Coil Manufacturing & Repair Company, Cleveland, Ohio, is the name of the concern formerly known as the Cleveland Coil & Manufacturing Company. The new company took charge of the business on Dec. 31, and will be engaged in making armatures, field and induction-motor coils and a general rewinding and repairing business. Until about three years ago the business which the above company has assumed was conducted by the electrical department of the Van Dorn & Dutton Company. The principal owner and manager of the Coil Manufacturing & Repair Company is Mr. H. A. Kuehle, formerly with the Cleveland Switchboard Company and the Electric Wiring Company, of Cleveland.

Electric Appliances Selling Well in Kansas City.—Mr. C. H. Talmage, sales manager for the Kansas City (Mo.) office of the Western Electric Company, states that the sales of ranges and other appliances for cooking in his territory has been very large. The increase is said to be about 1000 per cent over that of other years. Mr. Talmage feels that the time is close at hand when electricity for heating and cooking will come into its own, although in Kansas City, on account of the low cost of gas, the competition is keen where the cost element is considered. Mr. Talmage is very optimistic regarding the future and expects the business of the Kansas City office to be even better than that of the banner year of 1914.

Developments in Washing Machines.—The Capital Electric Company, 231 Insurance Exchange Building, Chicago, Ill., manufacturer of washing machines, is working on two models of electric washers, which will soon be ready for the market. The company has also improved the machine described in the ELECTRICAL WORLD of April 18, 1914, by the addition of a handle to the cylinder so that the latter can be easily lifted from the tub or raised above the water line. The arrangement is such that when the machine is in operation the handle does not impede the motion of the cylinder. According to Mr. H. D. Payne, sales manager of the Capital Electric Company, the recent general depression has not appreciably affected the business of the concern.

Big Year for Northern Equipment Company.—The annual report of the Northern Equipment Company, Erie, Pa., manufacturer of the "Copes" boiler-feed water regulator and pump governor, shows that 1914 was the greatest year in the history of its business, the amount of sales exceeding that of the next best year by 9.5 per cent. The above company has combined with the Erie Pump & Engine Works, and Mr. J. H. Dougherty, formerly with the International Steam Pump Company, will be placed in the charge of centrifugal pump design. The new combination will be known as the Erie Pump & Equipment Company. The officers of the new company are: President and treasurer, E. W. Nick; vice-president, D. H. DuMond; secretary, V. V. Venschoten.

Record Output of Domestic Lead.—According to preliminary figures compiled by the United States Geological Survey, there was an increase of nearly 100,000 tons in the production of lead in the United States for 1914 over that of any preceding year. There was a heavy decrease in the tonnage of lead of foreign origin treated in the United States, and for the first time in years, it is declared, a great increase in the quantity of domestic lead exported to European countries was noted. At the same time the average price of lead in the United States was the lowest since 1898. The production of refined lead, desilverized and soft, from domestic and foreign ores in 1914 was approximately 537,079 short tons, worth at the average New York price $41,892,162, compared with 462,460 tons, worth $40,696,480, in 1913, and with 480,894 tons in 1912. The total production of lead, desilverized and soft, from domestic ores, was about 511,784 tons, almost 100,000 tons more than in any previous year and 25,000 tons more than the total output of the country from both domestic and foreign sources in any previous year.

Motor-Driven-Appliance Exhibit in Department Store.—The Crocker-Wheeler Company, Ampere, N. J., will place on display a number of its motors at the "Made in Newark" exposition to take place in the L. Bamberger department store, Newark, N. J., Feb. 23-27. The company will maintain four model rooms—a laundry, kitchen, dining room and business office. A number of different appliances will be shown in connection with the exhibit. It is the intention of the Crocker-Wheeler Company to make the display as varied as possible, and it is endeavoring to interest a number of manufacturers in the show.

Manufacturers' Prosperity Depends on Ability of Public Service Companies to Sell Securities.—In a letter to the ELECTRICAL WORLD Mr. C. L. Matthews, vice-president and secretary of W. N. Matthews & Brother, St. Louis, Mo., declared that many people do not seem to realize that prosperity cannot exist with the manufacturers who supply the needs of the public service corporations unless the latter can properly dispose of their securities. "Those who have studied financial cycles," he writes, "know that the sale of securities invariably follows an increase in banking funds in this country to some extent, but more particularly in the Bank of France. It does not seem that regular 'boom times' are due until after the end of the war and after the holding funds in the Bank of France get well above normal. So far as I can find from a search of the past, prosperous times in this country have not existed when the Bank of France has been extended. This is owing to the fact that the greater part of our securities are floated in France and to a lesser degree in other European countries. I believe we are going to see a gradual improvement in the electrical business. In fact, I may say that our business has shown an upward trend since the first of November."

Gas-Electric Vehicle Patents.—In recent years the gas-electric transmission for the propulsion of heavy vehicles both upon roads and rails has slowly but steadily grown in favor. It has shown itself particularly advantageous as regards reliability and the cost of maintenance, and the value of these two factors is now being appreciated for the first time. In the present European war the motor-driven vehicle has been a most important factor and frequent reference has been made to what is known as the "four-wheel drive and steer." Many of the desirable features of gas-electric transmission, one of which is the "four-wheel drive and steer," seem to be covered in a group of four patents issued on Dec. 15, 1914, to Mr. H. Ward Leonard based on applications filed in the Patent Office more than ten years ago. In these patents, which relate especially to the problems of heavy road vehicles, are disclosed means for eliminating many of the most serious difficulties of the "straight gasoline" type of vehicle, with especial reference to the control problems which become serious as the weight of the vehicle increases when use is made of change gears, clutches, etc. Although the "gas-electric" vehicle weighs somewhat more and costs somewhat more than the "straight gasoline" type, yet it is claimed that for heavy service it is better.

Orders for Electric Equipment.—The Hershey Transit Company, of Hershey, Pa., has just purchased several four-motor equipments and control apparatus from the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. These equipments will be used on cars operating from Hershey to Hummelstown and Campbellstown, connecting with the Harrisburg Railway Company at the former point. The apparatus just ordered is to be an addition to Westinghouse equipment already installed. The Detroit United Railways Company has placed an order with the Westinghouse company for a 50-ton Baldwin Westinghouse locomotive. This machine is to be used between Royal Oaks, just outside the city limits of Detroit, and Flint, a distance of about 55 miles. Other companies which have ordered traction equipment are the following: The Danville Traction & Power Company, operating between Danville and Schoolfield, Va., and the Birmingham-Tuscaloosa Railway & Utilities Company. The order from the latter company includes a 500-kw rotary converter, three 185-kva transformers, a switchboard and one quadruple equipment with control apparatus for a combination baggage, express and freight car. This company has also placed an additional order for substation and car equipment to be used in connection with the electrification of a portion of the road near Tuscaloosa, Ala.

Electric Trucks for the United States Government.—The Waverley Company, of Indianapolis, has under construction for the navy yard on Puget Sound, Wash., a 3-ton electric truck and a 3-ton trailer which will be designed for handling plates and angles from storage to machines and from machine to machine in the Naval Repair Shop. The wheelbase of the tractor will be 66 in. and the platform of the car 5 ft. by 11 ft., the principal overhang being in front of the front axle. The battery will consist of forty-two cells, which will be divided between two battery boxes, one between the wheels and the other under the forward overhang. Mounted on the platform of each car will be a turntable 5 ft. 2 in. in diameter running on rollers and operated by hand spikes for the quick and convenient unloading of the heavy plates or beams that it will be designed to carry.

Production of Copper Decreased in 1914.—According to figures and estimates collected by the United States Geological Survey, the copper production of the United States in 1914 showed a marked decrease from that of 1913. At an average price of about 13.5 cents per lb. the 1914 output has a value of $152,400,000, compared with $189,795,000 at an average price of 15.5 cents per lb. for the 1913 output. According to the statistics and estimates received, the output of blister and Lake copper was 1,129,000,000 lb. in 1914 against 1,224,484,000 lb. in 1913. The output of refined copper from primary sources, both domestic and foreign, for 1914, it is estimated, was 1,493,000,000 lb., compared with 1,615,067,000 lb. in 1913. According to the Bureau of Foreign and Domestic Commerce, the imports of pigs, ingots, bars, etc., for the first eleven months of 1914 amounted to 187,433,676 lb., and the copper contents of ore matte and regulus amounted to 97,348,866 lb., a total import of 284,782,542 lb. This compares with an import for the twelve months of 1913 of 409,560,954 lb. The exports of pigs, ingots, bars, plates, sheets, etc., for the first eleven months of 1914 amounted to 780,048,777 lb., compared with an export for the twelve months of 1913 of 926,441,142 lb. At the beginning of 1914 there was about 90,000,000 lb. of refined copper in stock in the United States. This added to the refinery production gives a total available supply of about 1,583,000,000 lb. of refined copper. On subtracting the export from this, with an estimate for December, it is apparent that the supply available for domestic consumption is materially below the 812,000,000 lb. of 1913, without taking account of stocks held at the close of the year.

Walker Vehicle Company Adds Passenger-Car Department.—The Walker Vehicle Company, Chicago, has purchased the factory and business of the Chicago Electric Motor Car Company, adding the latter's line of electric passenger cars to its own business, which has been heretofore confined exclusively to commercial electric trucks. Salesrooms have been opened in a modern structure built for the purpose at 2700 Michigan Boulevard, Chicago, for the display and sale of electric passenger cars, and Mr. Gail Reed, formerly secretary and sales manager of the Chicago Electric Motor Car Company, has been appointed sales manager of the Walker company's new passenger-car division. The manufacture of "Chicago electrics" will be continued at the Walker factory, 531 West Thirty-ninth Street, Chicago, with modifications and improvement in designs from time to time. The Walker company is also prepared to continue service to present owners of Chicago Electric cars. Later it is planned to bring out a business man's electric passenger car which will, it is believed, have a wide field of usefulness, and which can be sold at a reasonable price. The Walker Vehicle Company has been engaged in the manufacture of electric commercial cars for the last six years, and a number of its officers are prominent in the management of the Commonwealth Edison Company of Chicago. Mr. W. A. Fox, president of the Walker Vehicle Co., is vice-president of the Commonwealth Edison Company, and Mr. G. A. Freeman, of the Edison company, is vice-president of the Walker Company. Messrs. J. F. Gilchrist and J. H. Gulick, vice-presidents of the Edison company, are members of the board of directors of the vehicle company, together with Messrs. Fox and Freeman and Mr. G. R. Walker, the designer whose name the concern bears. The Walker Vehicle Company has sales offices in Minneapolis, Boston, New York and Cincinnati.

New Industrial Companies

The Pettibone-Mingay Electric Supply Company, of Niagara Falls, N. Y., has been incorporated with a capital stock of $5,000 by C. P. Mingay, L. A. and L. W. Pettibone.

The New Light & Supply Company, of Boston, Mass., has been incorporated with a capital stock of $50,000 by W. B. Wheeler, F. A. Kidder and D. A. Freeman, of Boston, Mass.

The Royal Incandescent Supply Company, of New York, N. Y., has been chartered with a capital stock of $1,000. Henry Hartman, 20 Vesey Street, New York, N. Y., is attorney.

The Electric Storage Battery Service Company, of Tulsa, Okla., has been incorporated with a capital stock of $1,000 by H. M. Prewett, J. E. Washington, Jr., and John Y. Morgan, Jr., Tulsa.

The Electric Ricket Machine Company, of Chicago, Ill., has been incorporated with a capital stock of $100,000 to manufacture machinery and appliances. The incorporators are E. W. Mosher, E. H. Tillson and F. R. Wescott.

The Edwards Lighting & Fixture Company, of Chicago, Ill., has been incorporated by L. J. Georgen, J. L. Cushing and L. V. Hult, of Chicago, Ill. The company is capitalized at $25,000 and proposes to manufacture machinery and appliances.

The Current Saving Electric Sign Company, of New York, N. Y., has been incorporated with a capital stock of $16,000 by George F. Hummel, 1478 Broadway; Lawrence L. Brown and Joseph G. Williams. C. L. Clune, 2 Rector Street, New York, is attorney.

The York Products Company, of New York, N. Y., has been chartered with a capital stock of $55,000 to manufacture electrical and mechanical machines, and supplies, etc. The incorporators are J. J. Donohue, E. F. Phillips and J. Lee, of New York, N. Y.

Habacht & Weiss, of New York, N. Y., have filed articles of incorporation with a capital stock of $3,000 for the purpose of manufacturing gas and electric fixtures. The directors are Harry Habacht, Max Weiss and Solomon Brinn. S. Brinn, 63 Park Row, New York, N. Y., is attorney.

The California Beacon Miniature Electric Company, of New York, N. Y., has been incorporated by M. L. Kaplan, S. I. Posen and W. Rosin, 1823 Eighty-second Street, Brooklyn, N. Y. The company is capitalized at $25,000 and proposes to manufacture and deal in appliances, machinery, lamps, batteries, etc.

The Quaker City Engineering Company has filed articles of incorporation under the laws of the State of Delaware. The company is capitalized at $50,000 and proposes to do a general electrical and mechanical engineering business. The incorporators are H. E. Latter, W. J. Maloney and O. J. Reichard, of Wilmington, Del.

The Terminal Electrical Utilities Company, of New York, N. Y., has been incorporated by Max M. Kotzen, Abraham A. Kotzen, and Henry Amster. A. A. Kotzen, 51 Chambers Street, New York, is aatorney. The company is capitalized at $1,000 and proposes to do general electrical work and deal in appliances, etc.

The Electric Ticket Machine Company, of Chicago, Ill., has been incorporated by E. W. Mosher, and Frank R. Westcott; correspondent, Alvan L. Ringo, corporation counselor, Security Building, 189 West Madison Street, Chicago. The company is capitalized at $100,000 and proposes to manufacture and deal in machinery, appliances, etc.

The Minerallac Electric Company, 400 South Hoyne Avenue, Chicago, has purchased the business of the Altman Company, formerly at 69 Dearborn Street, Chicago, and will manufacture the Altman weighted desk pushes in improved designs. These pushes are made with one to nine buttons, and can be furnished in mahogany, oak and sycamore to match office furniture.

The Universal Welding & Manufacturing Company, of Queens, has been incorporated with a capital stock of $10,000 to manufacture lamps, heat and lighting appliances (gas and electric, etc.); also to manufacture metal articles, etc. The incorporators are: Anna V. Kenealy, 516 Twelfth Street, Brooklyn; William F. Fund, 2676 Morris Avenue, New York, N. Y., and Thomas F. Doyle, 98 Elm Street, Astoria, N. Y.

Trade Publications

Bench Drill.—A motor-driven bench drill is described in a leaflet sent out by H. G. Crane, Brookline, Mass.

Battery Charging Apparatus.—The Esterline Company, Indianapolis, Ind., is sending out a booklet entitled "Profit in Storage Battery Charging."

Small Lighting Set.—Fairbanks-Morse & Company, Chicago, Ill., have published a folder which is descriptive of a gas-engine-operated lighting plant.

Reamer for Bearings.—The Harding Distributing Company, Boston, Mass., has issued a booklet which describes the "Martell" aligning reamer for bearings.

Attachment Plug.—The Best Electric Company, Pittsburgh, Pa., is sending out a leaflet which describes its recently developed swivel attachment plug.

Electric Sterilizer.—The Victor Electric Company, Jackson Boulevard and Robey Street, Chicago, Ill., has recently issued a leaflet which describes an improved electric sterilizer.

Storage Battery.—"What Owners Say About Ironclad Exide Batteries" is the title of a booklet recently published by the Electric Storage Battery Company, Philadelphia, Pa.

House-Wiring Plan.—The Edison Electric Illuminating Company, Brooklyn, N. Y., has issued an illustrated folder which describes a plan for wiring homes on an easy-payment plan.

Electric Washing Machine.—"The Capital Safety First Electric Washer" is the title of a booklet issued by the Capital Electric Company, Insurance Exchange Building, Chicago, Ill.

Fans.—A booklet designated as B-3328, recently issued by the General Electric Company, Schenectady, N. Y., contains information on a number of different types of electrically operated fans.

Direct-Current Generators.—The Robbins & Myers Company, Springfield, Ohio, has issued Bulletin No. 111, which contains information on its type "S" steel-frame direct-current generators.

Electric Incubators.—The Electric Specialty Company, 154 South Main Street, Salt Lake City, Utah, has issued a catalog which contains information on its double-deck and single-deck electrically operated incubators.

Electrical Devices. — Catalog No. 3 issued by the Fahnestock Electric Company, 129 Patchen Avenue, Brooklyn, N. Y., contains information on several types of spring binding posts and other electrical devices.

Brush-Holder Equipment.—"Commutation Troubles and Their Elimination" is the title of Bulletin No. 516 issued by the Baylis Company, Bloomfield, N. J., which contains information on the company's reaction brush-holder equipment.

Woven Fabric.—The Chernack Manufacturing Company, Pawtucket, R. I., has issued a folder entitled "Weaver versus Braid," and Bulletins Nos. 1, 2, 3, 4, 5, 6 and 7, which contain information on woven fabric and the looms for making the product.

Ornamental Standards and Brackets.—The Electric Railway Equipment Company, Cincinnati, Ohio, has issued an attractively illustrated catalog which contains information on ornamental standards and brackets for high-efficiency tungsten lamps.

The Steel City Electric Company, Pittsburgh, Pa., is sending out several loose pages which are additions to its Bulletins No. 25, No. 26, No. 27 and No. 28. These pages contain tables on prices and information on beam straps and hickey fixture hangers.

Pull Switches and Reflectors.—Harvey Hubbell, Inc., Bridgeport, Conn., has issued Bulletin No. 15-6, which describes and illustrates a fixture pull switch, and Bulletin No. 15-5, which contains information on small half reflectors for 10-watt and 15-watt lamps.

Diesel-Engine Tests.—The Busch-Sulzer Brothers Diesel Engine Company, St. Louis, Mo., has published results of tests conducted by Dr. A. C. Scott, Dallas, Tex., to determine comparative economies of a 225-hp Diesel engine set at Hugo, Okla., under conditions of steady and fluctuating loads.

Construction News

New England

AUGUSTA, MAINE—The Central Maine Pwr. Co. has submitted a proposal to the City Council offering to replace the 60-cp lamps now in use with 250-cp lamps and the arc lamps with new nitrogen lamps of 600 cp, provided the city will sign a contract for five years' service. The proposal also included replacing the 32-cp lamps at South Gardiner and on the Gardiner and Randolph bridge with 100-cp lamps.

BANGOR, MAINE.—The city of Bangor has placed a contract with the S. Morgan Smith Co., of York, Pa., for two 45-in. vertical wicket-gate wheels for the municipal water-works station. The wheels are to be controlled by a Lombard governor and drive a 150-kva generator from a jackshaft. The power to be developed is to be used in connection with the water-works system. The electrical equipment will be furnished by the General Electric Co.

BELFAST, MAINE.—The Penobscot Bay El. Co., it is reported, is contemplating developing the water-power at the Sherman lower mill site for use at its East Side station. If the power is developed, the water will be carried to the station through a tube about 3500 ft. long.

MANCHESTER, N. H.—Plans are being prepared by the Manchester Trac., Lt. & Pwr. Co. for placing its wires underground in the business section of the city.

JOHNSON, VT.—The Ithiel Pwr. Co., recently incorporated with a capital stock of $150,000, is developing 4000 hp on the Lamoille River at Johnson, Vt. The company has not yet decided upon equipment for its proposed plant, or length of transmission line, as it has two markets for its entire output. F. A. Walker, of Barre, is engineer in charge of the work. The Light, Heat & Pwr. Corpn., 77 Franklin Street, Boston, Mass., has the contract for construction of plant. Charles H. Thompson, P. O. Box 453, Montpelier, is treasurer and manager of the Ithiel Falls Pwr. Co.

LYNDONVILLE, VT.—Contracts have already been placed by the village of Lyndonville for complete hydroelectric equipment for the new municipal power station. Two 450-hp Francis type turbines in cast-iron spiral cases, each turbine to be regulated by Woodward oil-pressure governor, will be furnished by the S. Morgan Smith Co., of York, Pa. The General Electric Co., of Schenectady, has the contract for the entire electrical equipment.

MONTPELIER, VT.—The stockholders of the Montpelier & Barre Lt. & Pwr. Co. have authorized an increase of capital stock from $2,310,000 to $4,810,000.

ATHOL, MASS.—The Massachusetts Gas and Electric Light Commission has granted the Athol Gas & El. Co. permission to issue $320,000 in capital stock, the proceeds to be used to meet the cost of extensions to plant, including the development of steam and hydraulic stations and the purchase of the property of the Orange El. Lt. Co.

BOSTON, MASS.—Plans have been approved for extending the ornamental lighting system through Copley Square and down Boylston and Tremont Streets to Scollay Square.

BOSTON, MASS.—The contract for electrical wiring at the Nurses' Home and two ward buildings at Long Island, Boston Harbor, has been awarded to the Carlisle Connor Co., 258 Washington Street, Boston.

SPRINGFIELD, MASS.—The United El. Co., of Springfield, has applied to the State Board of Gas and Electric Light Commissioners for permission to issue 2500 shares of new capital stock at the par value of $100 a share, the proceeds to be used to pay off outstanding indebtedness incurred in making extensions and improvements to system and for further extensions and improvements contemplated.

EAST HADDAM, CONN.—The East Haddam El. Lt. Co. has filed a petition with the Secretary of State asking that legislation may be granted authorizing the company to extend its lines to and furnish electrical service in the town of Lyme, and especially in the northerly portion of Hadlyme and vicinity.

Middle Atlantic

BINGHAMTON, N. Y.—The Binghamton Lt., Ht. & Pwr. Co. (operating under an entirely new management) has requested the Board of Contract and Supply to grant the company a hearing, in order that it may present its position in regard to furnishing the city with electricity. The communication states that the company is ready to make a contract with the city for any length of time desired at a cost to the taxpayers lower than can be obtained by building a new municipal electric-light plant. S. H. Dailey is general manager.

BUFFALO, N. Y.—The Aldermanic water committee has recommended that the contract for electrical apparatus for the new pumping station at the foot of Porter Avenue be awarded to the Buffalo El. Construction Co., at $48,900. The cost of the plant complete is estimated at about $95,000.

HANNAWA FALLS, N. Y.—The Public Service Commission has approved an issue of bonds by the Hannawa Falls Pwr. Co. to provide funds for the purchase of equipment and machinery, including a 51-in. Allis-Chalmers waterwheel and governor and a General Electric 4500-kva, three-phase, 60-cycle, 4400-volt generator (directly connected), water-cooled transformers, with panels, switches, accessories and equipment, and other transformers, circuit feeders, switches, insulators, etc.

LA SALLE, N. Y.—The village of La Salle is contemplating the installation of a municipal electric-light plant.

NEW YORK, N. Y.—Bids will be received by Robert Adamson, fire commissioner, Headquarters of the Fire Department, Municipal Building, New York, until Jan. 15, for furnishing four motor-driven fuel wagons. Blank forms and further information may be obtained at the above office.

NEW YORK, N. Y.—Bids will be received by the Board of Trustees of Bellevue and Allied Hospitals, Department of New York City, Twenty-sixth Street and First Avenue, borough of Manhatan, until Jan. 15, as follows: (1) For furnishing all labor and materials required for excavation, masonry, carpentry, steel and iron work, metal work and roofing, painting and glazing, hardware, electric work, refrigerating and drinking water and all other work for the alterations to the present main building of the Harlem Hospital, 136th and 137th Streets and Lenox Avenue; (2) for alterations and additions to plumbing and gasfitting for main building of Harlem Hospital; (3) for plumbing work for alterations to the power house and ambulance station of the Harlem Hospital; (4) for heating and ventilating work for alterations to the power house and ambulance station of the Harlem Hospital. The bidder will state one aggregate price for the whole work described under Nos. 1, 2 and 3, and a separate price for the heating and ventilating work. Blanks and further information may be obtained at the office of the contract clerk and auditor, No. 400 East Twenty-ninth Street, borough of Manhattan.

NYACK, N. Y.—The Rockland Lt. & Pwr. Co., of Nyack, has been granted permission by the Public Service Commission to issue $100,000 in bonds, the proceeds to be used for the erection of new electric distribution and service wires, cooling-pond construction, new gas mains, service pipes, meters and connections, the payment of obligations already incurred on these accounts; for land in Spring Valley for substation and district office building, and the right-of-way for the proposed transmission line from West Nyack through Spring Valley and Monsey to Hillburn.

PORT JERVIS, N. Y.—The installation of an ornamental lighting system in the business district is under consideration.

SCHODACK, N. Y. (not a post office).—The Public Service Commission has granted the Albany Southern R. R. Co., of Hudson, permission to supply electricity for lamps, heaters and motors in Schodack.

STAMFORD, N. Y.—The Town Board has granted the application of the taxpayers of South Kortright for establishing an electric-lighting district in that village.

BRISTOL, PA.—A permit has been granted for the construction of a power house and cold-storage plant for the W. H. Grundy Co. The building will be 56 ft. by 175 ft., two stories high; engine room, one story, 52 ft. by 105 ft., including smokestack 12 ft. in diameter. The equipment will consist of mechanical stokers, engines, boilers, generators, pumps, etc. J. M. Whitman is engineer.

DALLASTOWN, PA.—Arrangements have been made whereby the streets of the borough will be lighted by electricity instead of gas, the service to be supplied by the Edison El. Lt. & Pwr. Co., of York. The contract is for a period of five years and provides for 60 lamps of 80 cp.

HONEY BROOK, PA.—The electric lighting ordinance recently passed by the Council has been approved by Burgess E. J. Long, and work will soon begin on construction of the proposed plant.

JENKINS, PA. (not a post office.)—The Township Supervisors have awarded the contract for street-lighting to the Jenkins Township El. Lt. & Pwr. Co., recently organized. The contract is for a period of five years and provides for 72 or more lamps of 250 cp. Work will begin immediately on the installation of an electric plant and distribution system. The service is now supplied by the Citizens' El. Illg. Co., of Pittston.

KITTANNING, PA.—The Public Service Commission has approved the contract of the Kittanning El. Lt. Co., of Kittanning, and the borough of Ford City, for the installation of an electric-light plant in that borough.

PHILADELPHIA, PA.—Bids will soon be asked for equipment for the power plant to be erected at the Home for the Indigent at Holmesburg. Proposals for the construction of the building will be opened on Jan. 12. R. H. Harte, M. D., is director of public health and charities, and Philip H. Johnson, 1824 Land Title Building, is architect in charge.

SEVEN VALLEYS, PA.—The local electric-light plant, it is reported, is being rebuilt for the purpose of furnishing electrical service in New Salem, Paradise, Loganville and Hanover Junction. A new company, it is understood, will be organized to take over and operate the plant.

HIGHTSTOWN, N. J.—Owing to the unsatisfactory service furnished by the Hightstown Lt. & Pwr. Co. a movement has been started to establish a municipal electric-lighting plant here.

NEWARK, N. J.—Bids will be received by the Board of Education until Jan. 12 for the construction of the new McKinley School on Eighth Avenue, including electric work, heating and ventilating, lighting fixtures and vacuum cleaning system. R. D. Argue, City Hall, Newark, is secretary of board.

UNION HILL (WEEHAWKEN), N. J.—Arrangements are being made by the City Council for the installation of a new street-lighting system by the Public Ser. El. Co. to replace the present arc lamps. The new contract provides for 43 nitrogen lamps of 1000 cp and 114 400-cp nitrogen lamps.

DENTON, MD.—The Peninsular Lt. & Pwr. Co., of Denton, is erecting a new power house, contracts for which have been awarded. T. Pliny Fisher is president.

CHESTER, W. VA.—The city clerk, it is reported, has been authorized to advertise for bids for the installation of a municipal electric-light plant.

BUCHANAN, VA.—Arrangements have practically been completed whereby the Virginia-Western Pwr. Co., of Clifton Forge, will be granted a 30-year franchise to supply electricity in Buchanan.

DAYTON, VA.—At an election to be held Jan. 19 the proposal to issue $30,000 in bonds for the installation of an electric-light plant, water-works and sewer system will be submitted to the voters.

WINCHESTER, VA.—The Northern Virginia Pwr. Co., of Winchester, is reported to be preparing plans to raise the concrete dam across the Shenandoah River at Millville, to increase the output of its hydroelectric plant there.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Jan. 19 for furnishing at the various navy yards and naval stations supplies as follows: Brooklyn, N. Y., Schedule 7759—36 trolley hoists for handling 14-in. shells, 10,000 lb. hard-rolled sheet copper; Schedule 7756—Miscellaneous switches and mates, frogs, etc.; Schedule 7762—one smoke indicator system; Schedule 7775—Miscellaneous interior communication cable, 400,000 ft. silicon bronze aerial wire, miscellaneous double-conductor wire for portables, miscellaneous plain wire, miscellaneous magnet wire, 1400 ft. rattail wire; Schedule 7772—1750 lb. copper trolley wire. Charleston, S. C., Schedule 7756—Three water weighters for measuring condensed steam. Norfolk, Va., Schedule 7772—2000 carbons for Adams-Bagnall lamps; Schedule 7762—86 telephones, type CN; Schedule 7767—74,500 steel boiler plate, class B. Washington, D. C., Schedule 7758—One 100-hp induction motor; Schedule 756—Two 120-kw oil-cooled transformers. Boston, Mass., and Norfolk, Va., Schedule 7767—214,400 lb. steel boiler plate, class C. Bids will also be received at the same place until Jan. 26 as follows: Key West, Fla., Schedule 7779—2200 ft. single-conductor cable. Newport, R. I., Schedule 7782—Miscellaneous air pressure gages. Washington, D. C., Schedule 7782—Miscellaneous pressure regulators. Brooklyn, N. Y., Schedule 7789—2800 lb. seamless brass tubing; Schedule 7790—Miscellaneous unfinished composition unions; Schedule 7779—66,000 ft. telephone wire; Schedule 7791—Miscellaneous steel boiler plates. Bids will also be received at the same place until Feb. 2 for the following supplies: Puget Sound, Wash., Schedule 7795—Nine contact makers, 49 telephones, type CN. Brooklyn, N. Y.; Norfolk, Va., and Puget Sound, Wash., Schedule 7794—

Miscellaneous separators, insulators and battery jars. Applications for proposals should designate the schedule desired by number.

WASHINGTON, D. C.—Foreign trade oppotunities as announced by the Bureau of Foreign and Domestic Commerce in the Daily Consula Reports: No. 14,925—An American consular officer in a neutral country has transmitted a request from a government agent for immediate offers of ships' electrical appliances, submarine mines, etc. No. 14,666—A neutral government advises an American consular officer that it is in the market for six or eight seachlights for army and navy; also portable searchlights, with gasoline engines, or with Edison accumulators. It is stated that the searchlights should be of 60 cm to 90 cm and 1 m to 50 cm in diameter; that they should be provided with the necessary electric power —14 hp for the smaller and 35 hp for the larger lights. Catalogs or photographs and price lists should be sent to the American consular officer. No. 14,968—A firm in the West Indies informs an American consular officer that it desires to be placed in communication with American firms exporting electrical supplies of all kinds. Materials for wiring houses, etc., are desired in particular. No. 14,950—A business man in the East Indies informs an American consul that he wishes to receive catalogs and price lists from American exporters of electrical goods, dynamos, engines, furniture, labor-saving devices, etc. No. 14,971—An American commercial attaché in a foreign capital states that there is a market in that country for electric hand flashlamps for the use of pedestrians. The lamp should retail for about $1. No. 14,975—An import agent in Northern Europe advises an American consular officer that he desires to hear from American exporters of electric pocket lamps and dry batteries. No. 14,977—A merchant in a European capital has informed an American consular officer that he desires to act as agent in his country for an American manufacturer of electric supplies, such as accumulators, electrical appliances for automobiles, dynamos, transformers and wire installation. The merchant offers references as to his financial responsibility and is willing to give banker's security for such goods as he takes. No. 14,993—An import agent in France has informed an American consul that he wishes to form connections with American manufacturers of dry cells for bells for telgraphic and telephonic use, for pocket lamps and also of small electrical apparatus. He is desirous of obtaining terms to cover a stock of dry cels to be held at a distribution point. No. 15,001—A civil engineer, owner and manager of two stores in a European country, informs an American consular officer that he would like to hear from American manufacturers of insulators with a view of undertaking the exclusive sale of such goods in the country in which he lives. No. 14,980—A commission merchant in Europe informs an American consular officer that he wishes to correspond with American manufacturers of naked copper wire (electrolytic and commercial), silicium bronze wire, copper tubes and sheets, brass tubes and sheets, silver, platina, new silver and lead wire, tin, zinc and tinplate, dynamos, large and small electrometers, electric fans, stoves, kitchen utensils, material for electric-lighting installations, bells, telephones and apparatus, and all accessories for high-tension and low-tension transmission lines. Correspondence may be in English. No. 14,981—An import agent in Europe informs an American consular officer that he wishes to hear from American exporters of carbons for arc lamps, etc. No. 14,982—An American consular officer in Europe reports the name and address of a firm which wishes to import complete outfits for aerial cable ways for the transportation of minerals. Correspondence should be in Spanish. No. 14,985—A firm in an insular possession advices an American consular officer that it desires catalogs, prices, terms of payment, etc., for engines using oil as fuel. The engines are to be used for operating sawmill machinery and threshing machines, etc. Correspondence should be in Portuguese. No. 14,990—An American consular officer in Europe reports that an American in that country wishes to establish a business for the representation of American goods. He wishes to represent American firms dealing in electrical, industrial, agricultural and mining machinery. No. 15,008—An American consular officer in Russia reports that a firm in his district desires the names and addresses of American manufacturers of screw plates and stamping lathes. The firm is especially interested in lathes for Edison screws for lamp holders and fuse blocks. Correspondence should be in Russian, German or French. No. 15,010—An American consular officer in Europe reports a general market in his district for all kinds of electrical novelties, such as lamps and general electrical supplies. No. 15,012—An American consular officer in Europe advises that a firm in his district is in the market for aluminum cross-bars to be used as wire contacts on trolley poles. No. 15,014—An American consular officer in Europe reports that a firm in his district desires to be placed in communication with manufacturers of barbers' supplies, including electrical apparatus. Catalogs and prices should be sent. No. 15,041—An engineer in a foreign country has advised an American consular officer that he desires to confer with American manufacturers of street railway equipment. The engineer expresses the opinion that American firms should get the contract for building the proposed subway, which, it is estimated, will cost about $40,000,000. The inquirer has indicated a desire to receive general information concerning rolling stock and equipment for street railways, together with literature relating to electric motor power in general. Correspondence preferred in Russian, otherwise in French or English. Further information may be obtained on application to the Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., or to the following branch offices: Room 409, United States Custom House, New York, N. Y.; 629 Federal Building, Chicago, Ill.; Association of Commerce Building, New Orleans, La.; 310 United States Custom House, San Francisco, Cal.; 521 Post Office Building, Atlanta, Ga.; 1207 Alaska Building, Seattle, Wash., and 752 Oliver Building, Boston, Mass.

North Central

BATTLE CREEK, MICH.—Improvements are contemplated by the City Commission to the Verona pumping station, including the installation of 5-hp motors and a transformer, to cost about $3,500.

BAY CITY, MICH.—The contract for a 1200-kw generator for the municipal electric-light plant has been awarded by the electric-light committee to the Westinghouse El. & Mfg. Co., of Pittsburgh, Pa.

CARLETON, MICH.—At an election held recently the proposal to grant the River Raisin El. Co., of Monroe, a 30-year franchise to supply electricity for lamps and motors in Carleton was carried. Energy to operate the proposed system will be supplied from a hydroelectric plant at Grape.

FLINT, MICH.—A substation is being erected on North Saginaw Street for the Michigan Lt. Co. The station will have an output of 1500 hp and will furnish energy for the local lines of the Detroit United Ry. Co. and for its suburban lines as far south as Atlas.

KALAMAZOO, MICH.—Further extension to the municipal lighting service to include the energy for lamps at the county building is now being considered by the city officials and Board of County Supervisors.

LANSING, MICH.—The installation of ornamental lamps on Washington, Michigan and Franklin Avenues, is under consideration.

POTTERSVILLE, MICH.—The village Council is considering the question of lighting the streets of the village by electricity.

AKRON, OHIO.—The City Council has decided to eliminate gas lamps for lighting the streets and alleys in Akron and has authorized H. W. Jones, city electrician, to prepare contracts with the Northern Ohio Trac. & Lt. Co. for the installation of electric incandescent lamps in all downtown alleys and in courts and alleys in the outlying sections.

CANAL DOVER, OHIO—The City Council has authorized F. Wather, chief engineer of the municipal electric-light plant, to prepare plans for the installation of a third generating unit in the municipal plant. The Council is also considering the installation of a new pump in the water-works station.

CEDARVILLE, OHIO.—The Ohio Public Utilities Commission has authorized the Dayton Pwr. & Lt. Co., of Dayton, to purchase the property of the Cedarville Lt. & Pwr. Co. for $25,000. It will be operated in conjunction with the Dayton company's system.

CINCINNATI, OHIO.—An electric-lighting plant, it is reported, will be installed in the new apartment house to be erected by Jerome Jackson in Avondale, at Reading Road and Avondale Avenue.

CINCINNATI, OHIO.—A moving-picture theater will be erected at Warsaw and Eighth Avenues, at a cost of $30,000, by John W. Weinig and others. The plans provide for an electric plant for the building. Zettle & Rapp are architects.

CLEVELAND, OHIO.—The Lake Shore El. Ry. Co., of Cleveland, has called a special meeting of stockholders for Jan. 25 to vote on the proposal to increase its capital stock from $1,000,000 to $1,500,000, and also to amend its charter so that the company may engage directly in the generation and distribution of electricity for lamps and motors.

CUMBERLAND, OHIO—Arrangements are being made by C. A. Vansickle, who was recently awarded a contract for street-lighting in Cumberland, for the installation of an electric plant. The equipment will consist of one 100-hp boiler, a 75-hp steam engine and one direct-current generator and accessories; for distributing system 125 white cedar poles will be required and 3 miles of wire. The street-lighting system will consist of 25 200-watt nitrogen tungsten lamps.

MASON, OHIO.—Contracts have been awarded for equipment for the municipal electric-light plant in Mason. The cost of the plant when completed will be about $11,523.

PORTSMOUTH, OHIO.—The Portsmouth Street Ry. & Lt. Co., it is reported, has issued $500,000 in bonds, the proceeds to be used to extend its lines from Sciotoville to Ironton, a distance of 22 miles, and to make other improvements to its system. The extension of the interurban railway will be built by the Ohio Valley Trac. Co.

SALEM, OHIO.—The City Council is considering the question of installing an electric-generating plant in connection with the water-works pumping station to supply electricity to maintain the municipal electric-lighting system. Energy is now furnished by the Salem El. Lt. & Pwr. Co. I. N. Russell is director of public service.

SOUTH CHARLESTON, OHIO. — The Dayton Lt. & Pwr. Co., of Dayton, has applied to the Village Council for a franchise to supply electricity in South Charleston.

YOUNGSTOWN, OHIO—A resolution authorizing the director of public service to advertise for bids for furnishing and maintaining a new electric-lighting system in accordance with plans prepared by H. Whitford Jones has been passed by the City Council.

STURGIS, KY.—The power plant of the West Kentucky Coal Co., we are informed, was not destroyed by fire, as reported in the issue of Dec. 26.

ANDERSON, IND.—The Board of Public Works has awarded the contract for generator and other equipment for the municipal electric-light plant to the Westinghouse El. & Mfg. Co., of Pittsburgh, Pa., at $43,700.

AURORA, ILL.—The State Public Utilities Commission has authorized the Western United Gas & El. Co., of Aurora, to issue $18,000 in bonds.

EMDEN, ILL.—The installation of an electric-lighting system in Emden is under consideration.

FAIRBURY, ILL.—Plans are being considered for the installation of a municipal electric-light plant in Fairbury.

HARTSBURG, ILL.—The Town Board has awarded the Orville Township El. Lt. & Pwr. Co. (recently organized) a contract to light the streets of the town with electricity.

LEBANON, ILL.—Plans, it is reported, are being prepared by Prof. A. M. Topping of Purdue University, Lafayette, Ind., for the installaion of a cluster-lamp lighting system.

MARION, ILL.—The State Public Utilities Commission has granted the Ohio Valley El. Co., of Marion, permission to supply electrical service in Norris City, Enfield and Omaha, Ill.

MATTOON, ILL.—Application has been made by the Central Illinois Pub. Ser. Co. to the State Public Utilities Commission for a certificate of convenience and necessity to erect and maintain a high-tension transmission line from Astoria to Ipava, Ill. The company has also applied for permission to construct and operate a high-tension transmission line from a connection with the present line of the company, from Hillsboro to Roodhouse, to the pumping station of the Hartwell drainage and levee district.

NEW HOLLAND, ILL.—Plans are under way, it is reported, for lighting the streets of the town with electricity.

BERLIN, WIS.—Plans are being considered by the Berlin Pub. Ser. Co. for the erection of a transmission line to Red Granite in conjunction with the Neshkora Lt. & Pwr. Co. to furnish energy to the granite companies. Both companies propose to furnish electrical service to residents along the proposed line.

GRANTSBURG, WIS.—At an election held recently the citizens voted against the proposal to dispose of the municipal electric-light plant. The village is contemplating the construction of a dam on Wood River and operating the municipal plant by water-power.

LANCASTER, WIS.—The State Railroad Commission has authorized the Lancaster El. Lt. Co. to issue $34,371 in capital stock, the proceeds to be used to purchase the

power and transmission lines between Platteville and Lancaster.

MILWAUKEE, WIS.—The City Council has directed the commissioner of public works to purchase and erect the necessary equipment to light the streets in the Twenty-second Ward, which is now without street lamps. The lamps will be erected and maintained by the city and energy to maintain them will be purchased from the Milwaukee El. Ry. & Lt. Co.

NEW RICHMOND, WIS.—The New Richmond Pwr. Co. has been granted permission by the State Railroad Commission to issue $10,000 in capital stock, the proceeds to be used for erection of transmission lines and purchase of electrical equipment.

TURTLE LAKE, WIS.—Plans are being considered for the installation of an electric-lighting system in Turtle Lake.

BREVATOR, MINN. — The Cloquet El. Co., of Cloquet, has applied to the Town Council for a franchise to supply electricity in this town. The company has commenced work on the erection of a transmission line from Cloquet to Brevator.

ELY, MINN.—Bids will be received by the School Board of the Independent School District No. 12 of St. Louis County, addressed to Thomas E. Miller, sercetary of board, Ely, until Jan. 12 for furnishing and installing lighting fixtures in the new 24-room school building at Ely.

HERMAN, MINN.—The installation of a municipal electric-light plant in Herman is under consideration.

MAPLETON, MINN.—A company has been organized by local business men to take over the local electric-light plant, owned by C. L. Sellers. The company will be known as the Mapleton El. Co. and will apply to the Village Council for a 30-year franchise to operate in Mapleton. After the franchise is granted the company proposes to make arrangement to secure electricity from the Rapidan company to operate its system. V. J. Creiner is president and E. Sellers manager of the Mapleton company.

GRAND JUNCTION, IA.—The local electric-light plant has been purchased by the Iowa Ry. & Lt. Co., of Cedar Rapids, which will take possession at once.

DONNYBROOK, N. D.—The installation of an electric-light plant in Donnybrook is reported to be under consideration.

MANDAN, N. D.—The City Commission is considering the installation of an ornamental street-lighting system in Mandan.

AURORA, NEB.—A 33,000-volt electric transmission line is being erected between Aurora and Hampton with the intention of extending it to York in the spring. The Aurora El. Co. will supply electricity to operate the municipal electric system in Hampton.

BLAIR, NEB.—Plans and specifications have been completed for the proposed municipal electric-light plant.

GRAND ISLAND, NEB.—The Central Nebraska Pwr. Co. has applied to the State Railroad Commission for permission to issue $900,000 in capital stock and $600,000 in bonds. The company has a grant of 1000 cu. ft. of water per second from the Middle Loup River and proposes to build a hydroelectric power plant at Boelus, at a cost of $1,500,000. It is estimated that 5000 hp can be developed, which will be transmitted to Grand Island, St. Paul, Loup City and possibly other towns in Central Nebraska. The Grand Island El. Co. is said to be behind the project. T. H. Fritts is manager of the Grand Island company.

McCOOK, NEB.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Jan. 26 for the construction complete, including mechanical equipment (except elevator, lighting fixtures and approaches), of the United States post office and court house at McCook, Neb. Drawings and specifications may be obtained at the above office or from the custodian of site at McCook. O. Wenderoth is supervising architect.

OMAHA, NEB.—The installation of an electric-light plant in connection with the Florence water-works plant is recommended by R. B. Howell, general manager of the Metropolitan Water District. It is proposed to begin in a small way after authority is granted by the Legislature and gradually extend the service, taking over first the public lighting system.

CORNING, KAN.—The City Council is reported to have awarded a contract for the erection of a transmission line from Centralia to Corning to supply electricity here.

LYONS, KAN.—Within the next three months the Lyons El. & Mfg. Co. expects to install a 100-kw to 150-kw generating unit driven by a Corliss or four-valve automatic belted engine. Dwight Chapin, Jr., is superintendent.

Southern States

WADLEY, GA.—The contract for construction of municipal electric-light plant has been awarded to Singleton-Smith Co., of Macon, for which bonds to the amount of $6,400 were recently voted.

MASON, TENN.—The City Council, it is reported, is contemplating the installation of a municipal electric-light plant.

GLENWOOD, ARK.—Options on land and frontage on Caddo River have been closed by O. E. Grimes, of Tulsa, Okla., and associates for the purpose of constructing a hydroelectric power plant to develop about 2500 hp. The cost of the work is estimated at about $250,000.

CONROE, TEX.—The plant of the Conroe Gin, Ice, Lt. & Pwr. Co. was recently destroyed by fire, causing a loss of about $15,000. The plant, it is understood, will be rebuilt at once.

DENTON, TEX.—At an election to be held on Feb. 2 the proposal to issue $12,000 in bonds for extensions and improvements to the municipal light and water systems will be submitted to the voters.

GAYLORD, TEX.—The installation of a street-lighting system, to cost about $7,000, is reported to be under consideration.

MISSION, TEX.—The City Commission is considering the question of calling an election to submit the proposal to issue bonds for the installation of a municipal electric-light plant to the voters.

Pacific States

SEATTLE, WASH.—The City Council has directed Mayor H. C. Gill and Comptroller Carroll, through the Legal Department, to make immediate application to the federal government for power permits on the Sauk and Suiattle Rivers, in the Washington and Snoqualmie National Forests, with a view to the possible development of a municipal power site in the two watersheds. It is estimated that 200,000 hp could be developed.

TACOMA, WASH.—The City Council has instructed Superintendent B. W. Collins to submit an estimate of the cost of replacing the transmission line on the east side of Commerce Street and cost of putting the wires underground.

WATERVILLE, WASH.—The contract for lighting the town, it is reported, has been awarded to Gray & Son, of Entait. It is understood that work will soon begin on the construction of an electric plant and distributing system.

MEDFORD, ORE.—The Rogue River Pub. Ser. Corpn. has submitted a proposal to the City Council offering to supply electricity in Medford, the city to install and operate the distributing system.

PILOT ROCK, ORE.—Plans are being considered for the installation of an electric-light plant in Pilot Rock. H. Freuler, of Walla Walla, Wash., engineer, is interested in the project.

RED BLUFFS, CAL.—Petitions have been presented to the City Trustees for the installation of electroliers on Main Street.

SACRAMENTO, CAL.—The Great Western Pwr. Co. has recently closed a contract with the city of Sacramento to supply energy to operate the sewage pumping plant. The total capacity of the pumping plant will be 264,000,000 gal. in 24 hours, which will be delivered by six centrifugal pumping units of 40,000,000-gal. capacity each, and by two centrifugal units of 12,000,000 gal. capacity each. Each of the larger pumps is to be directly connected to a 350-hp vertical squirrel-cage induction motor, and the small ones to 150-hp vertical motors. The total rating of motors will be 2430 hp. The plant is expected to be in operation by Feb. 1. The company has recently connected 1300 hp for draining Reclamation District 1000, consisting of 52,000 acres. The present installation consists of only 250-hp motors, but the complete installation will be five 650-hp motors.

STOCKTON, CAL.—Plans are being considered for the installation of electroliers on West Main Street.

TULARE, CAL.—The City Council has decided to install the electrolier-lighting system on 17 blocks (six to a block) in the business district, for which bids have already been asked.

SODA SPRINGS, IDAHO.—At a special election held recently the proposal to issue $15,000 in bonds for the installation of a municipal electric-lighting plant was carried. Paul Tipton is city clerk.

TUCSON, ARIZ.—At an election held recently the proposal to issue $8,000 for the installation of a municipal electric-light plant in Tucson was carried.

MOGOLLON, N. M.—The Socorro Mining & Milling Co., it is reported, will expend about $90,000 in completing its electric power plant near here. The plant when completed will supply electricity to operate machinery in the mines of the company and also to operate a number of industrial plants in this section.

Canada

VANCOUVER, B. C.—A. M. West, city engineer, has submitted a report to the Municipal Council of North Vancouver, providing for an ornamental street-lighting system from Ferry Wharf to First Street, single units to be used; 300-watt nitrogen tungsten lamps have been recommended.

CHATSWORTH, ONT.—A by-law will be submitted to the ratepayers at the January election authorizing the Council to negotiate with the Hydro-Electric Power Commission of Ontario to supply Niagara power.

PETERBOROUGH, ONT.—William Kennedy, Jr., of Montreal, Que., has been engaged to make investigations relative to the installation of a steam auxiliary plant for the town.

SANDWICH, ONT.—Petitions are being circulated in the township of Sandwich East and the village of Tecumseh for extension of the transmission lines of the Hydro-Electric Power Commission of Ontario. It is proposed to have one line extend along the Tecumseh road to the village and another along the river front.

ST. CATHARINES, ONT.—At a meeting of the joint Hydro-Electric Union of Niagara district held recently in St. Catharines it was decided to petition the Hydro-Electric Power Commission of Ontario to make additional surveys for hydro-radial electric lines from St. Catharines by way of Power Glen and Smithville, through the townships of Caistor, Binbrook and Barton, to Hamilton, also from Niagara Falls through the townships of Thorold and Stamford West, also to continue the survey for a line for Port Colborne north on the east side of Welland Canal, through Thorold Township and town, and to furnish estimates for same.

SCARBOROUGH, ONT.—The Scarborough Township Council has asked the Hydro-Electric Power Commission of Ontario to submit a report on the cost of installing a distributing system for lighting Birchcliffe and Kalmar Heights.

STRATFORD, ONT.—The Light and Heat Commission has decided to erect nitrogen-filled tungsten lamps on wooden poles now erected from Ontario Street to St. Patrick Street, and on every other pole from St. Patrick to the railway tracks beyond the Allis-Chalmers Co.'s plant.

OKA, QUE.—Fred M. Hoadley, consulting engineer, of Montreal, has been engaged by the Bishop of the Monastery at Oka to make investigations into the possibilities of developing a hydroelectric power plant on the river running through the property adjacent to the monastery. Electricity generated at the proposed plant will be used for different purposes in the institution, including lighting.

Mexico

GUANACEVI, DURANGO, MEX.—The Mexican Consol. Mining & Milling Co., it is reported, is contemplating the installation of an electric power plant at its mines here.

Miscellaneous

PANAMA—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until Jan. 13, for furnishing switchboard, transformer, cable clips, hasps and staples, strap hinges, brass tubing etc. Blanks and general information relating to this circular (No. 2010) may be obtained at the above office. Major F. C. Boggs is general purchasing officer.

PANAMA—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until Jan. 21, for furnishing cast-iron lamp-posts and porcelain receptacles and lamp sockets for same, electric cable, steel cable, steel pipe and pontoons for same, cast-iron washers, power hack saw, anchor lamps, etc. Blanks and general information relating to this circular (No. 890) may be obtained from the above office or offices of the assistant purchasing officers, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED DEC. 29, 1914.

1,122,259. MOTOR CONTROL; William M. Cummiskey, Honesdale, Pa. App. filed April 6, 1911. A circuit-closer for a slow-down resistor is operated automatically in accordance with the speed of the armature and position of the starting rheostat.

1,122,261. CIRCUIT CONTROLLER; William W. Dean, Chicago, Ill. App. filed Jan. 21, 1911. Operated by means of a push-button.

1,122,287. CHARGING SYSTEM FOR STORAGE BATTERIES; James F. Lincoln, East Cleveland, Ohio. App. filed Jan. 5, 1912. Charging generator driven by an alternating-current motor controlled automatically by the battery.

1,122,290. JUNCTION BOARD; Hereward M. Mack and Wallace P. Andrick, New York, N. Y. App. filed Jan. 21, 1913. For connecting cable ends.

1,122,297. SPARK-PLUG; Frank J. Muldoon, West Bend, Wis. App. filed May 22, 1914. A fireproof and oil-proof plastic filler compound surrounds the core.

1,122,326. HIGH-POTENTIAL INSULATOR; Louis Steinberger, New York, N. Y. App. filed Aug. 10, 1912. A metallic sleeve encircles the pendent portion of the insulator for attaching purposes.

1,122,332. CENTRIFUGAL SWITCH; Charles F. Sullivan, Des Moines, Ia. App. filed Nov. 18, 1912. Lugs are thrown outwardly to engage the contact members.

1,122,347. ATTACHMENT FOR TELEPHONES; Charles C. Wright, Camden, N. J. App. filed Feb. 9, 1914. Arranged for holding fresh paper in front of the mouthpiece.

1,122,351. BINDING POST; Henning F. Adickes, Jr., Biltmore, N. C. App. filed Jan. 16, 1914. Contains longitudinal and spiral grooves.

1,122,358. DETECTOR; Lester Stewart Barr, Washington, D. C. App. filed Sep. 10, 1913. Crystal floating on a mercury surface for use in radio signaling.

1,122,380. ELECTROMAGNETIC FRICTION COUPLING; Paolo Forster, Turin, Italy. App. filed June 5, 1913. Magnet used to force magnetic and non-magnetic portions into frictional contact.

1,122,383. WORKING SUBMARINE CABLES; John Gott, Brighton, England. App. filed May 17, 1913. Upon opening the key a relay is operated by the discharge of a condenser to reverse the connections of a battery to the line.

1,122,406. BUSHING FOR ELECTRICAL CONDUITS; Adnah McMurtrie, New York, N. Y. App. filed April 25, 1907. Provided with an aperture to receive either an armor sheath or a closing device.

1,122,424. PORTABLE ELECTRIC FLASHLIGHT; Charles J. Sagebrecht, Brooklyn, N. Y. App. filed May 21, 1914. Details of a portable battery lamp with reflector.

1,122,430. CIRCUIT-BREAKER; William M. Scott, Berwyn, Pa. App. filed Feb. 5, 1912. Provided with means for restoring the armature to normal position.

1,122,446. PORTABLE ELECTRIC LIGHT; Charles Wachtel, Brooklyn, N. Y. App. filed May 21, 1914. Details of a battery lamp with reflector.

1,122,468. ELECTRICAL PIANO PLAYER; Charles E. Brown, Columbus, Ohio. App. filed Sept. 2, 1913. Means for controlling from a distance the selection and operation of one or a group of clutches associated with music rolls.

1,122,478. ELECTRIC SAFETY FUSE; Robert C. Cole, Hartford, Conn. App. filed April 7, 1914. Fuse material is connected with spring heat coils.

1,122,483. ELECTROMECHANICAL VARIABLE-SPEED DEVICE; Henry H. Cutler, and Fredric S. Wilhoit, Milwaukee, Wis. App. filed Nov. 30, 1908. Several clutch members are arranged to act independently or conjointly according to the speed desired.

1,222,488. CIRCUIT-CONTROLLING APPARATUS; John W. Eskholme, Westfield, N. J. App. filed Sept. 23, 1909. Controller handle is advanced by a step-by-step mechanism.

1,122,490. METHOD OF OPERATING ALTERNATING-CURRENT MOTORS; Valere A. Fynn, St. Louis, Mo. App. filed March 29, 1912. In the rotor, which is short-circuited along one diameter at start, is introduced an external emf at low speeds, while the rotor is completely short-circuited at synchronous speed.

1,122,491. ALTERNATING-CURRENT MOTOR; Valere A. Fynn, St. Louis, Mo. App. filed Jan. 26, 1914. Primary equipment with winding having different pole numbers, and secondary arranged to have a low resistance for one number of poles and a high resistance for the other.

1,122,495. ELECTRICAL CONNECTION; Eugene Gindée, Paris, France. App. filed Nov. 11, 1912. A metallic tube is secured in the aperture of the brush, the conductor being held in the tube by compression.

1,122,521. ELECTRICALLY HEATED FLATIRON; Charles P. Madsen, Chicago, Ill. App. filed April 3, 1912. The heating unit is embedded in the insulating compound and housed in a recess in the iron.

1,122,534. GENERATOR; Ward S. Perry, Chicago, Ill. App. filed Sept. 19, 1910. The resistance of coils around the magnets is varied directly with the change in speed.

1,122,556. AUTOMATIC TRUNKING SYSTEM; Franklin J. Truby, Chicago, Ill. App. filed Jan. 18, 1911. Line wipers of a non-numerical trunking switch are always in engagement with the trunk line last employed by the switch for extending a call.

1,122,568. ELECTRIC INCANDESCENT LAMP; Edward P. Beckwith, Garrison, N. Y. App. filed Jan. 22, 1912. The filament holder is coated with a refractory material having high electric and heat-insulating qualities.

1,122,594. ART OF TRANSMITTING SOUNDS BY MEANS OF HERTZIAN WAVES; Walton Harrison, New York, N. Y. App. filed June 2, 1902. Involves the use of a selenium cell.

1,122,615. SENDER; John A. Kropp, Newark, N. J. App. filed July 29, 1913. The initial movement of the operating member from its normal position is ineffective, the complete return of the member to normal causes the actuation of the circuit interrupter, but the partial return is ineffective.

1,122,626. SELECTOR SWITCH; James L. McQuarrie, Montclair, N. J. App. filed July 30, 1913. The brushes are brought to rest on a predetermined set of terminals by means of mechanical stops.

1,122,632. CONNECTOR FOR ELECTRIC CONDUITS; James C. Phelps, Springfield, Mass. App. filed June 18, 1913. Each end cap is formed with a rib to register with the ribs on the base member.

1,122,633. DYNAMO-ELECTRIC MACHINE; Edwin S. Pillsbury, St. Louis, Mo. App. filed Jan. 19, 1912. Mechanical details of magnetic structure.

1,122,642. MULTIPLE BRUSH SELECTOR; John N. Reynolds, Greenwich, Conn. App. filed July 30, 1913. Revolving drums are arranged to be driven in one direction or the other.

1,122,657. CONTROLLER FOR ELECTRIC MOTORS; Harry F. Stratton, Cleveland, Ohio. App. filed July 17, 1913. Means for connecting the motor for dynamic braking to retard the motor.

1,122,665. SPOT WELDING MACHINE; Elihu Thompson, Swampscott, Mass. App. filed May 10, 1913. Use is made of converging welding electrodes and a co-operating mandrel within them forming the opposite electrode.

1,122,693. ELECTRICAL REGULATOR; Frank Conrad, Swissvale, Pa. App. filed Oct. 5, 1911. Comprises co-operating contact members, two actuating devices for one of them, and a yielding connection between one of the devices and the actuated contact member having a time-element function.

1,122,743. MOTOR CONTROL SYSTEM; Jay H. Hall, Cleveland, Ohio. App. filed April 5, 1906. A series of switches for cutting out resistance operating windings therefor energized by current in the controlled circuit and means for de-energizing the windings at will.

1,122,744. MOTOR CONTROL SYSTEM; Jay H. Hall, Cleveland, Ohio. App. filed Sept. 5, 1913. Means whereby the closure of one switch energizes the winding of a second switch and means controlled by the second switch for de-energizing the winding of the first switch.

1,122,752. SIGNALING AND INDICATING SYSTEM FOR ELEVATORS; William A. Hoeneman, New York, N. Y. App. filed May 29, 1913. An electrical signaling apparatus provided with make-and-break switching devices for signaling the car from any floor, operated by a snake wire.

1,122,754. TERMINAL CLIP FOR FUSE BLOCKS; Duncan C. Hooker, Farmington, Conn. App. filed April 7, 1914. Mechanical details.

1,122,774. METHOD OF CONTROLLING ELECTRIC ENERGY; H. W. Leonard, Bronxville, N. Y. App. filed April 16, 1913. Means for producing rhythmic fluctuations in the battery-charging energy while maintaining the average effect of the current constant independently of the voltage of the battery.

1,122,777. ELECTRIC SWITCH; Anker S. Lyhne, Bridgeport, Conn. App. filed Sept. 10, 1913. Details of a push-button switch for a pocket lamp.

1,122,778. PORTABLE ELECTRIC LAMP; Anker S. Lyhne, Bridgeport, Conn. App. filed Aug. 7, 1914. Details of a dry-battery lamp.

1,122,788. MOTOR CONTROL SYSTEM; Jacob F. Motz, Pittsburgh, Pa. App. filed July 21, 1913. Arrangements for utilizing the dynamic braking action of the motor to bring it to rest.

1,122,828. SWITCH MOVEMENT; Benjamin C. Webster, Bridgeport, Conn. App. filed Feb. 17, 1914. Details of a lamp socket.

1,122,843. LAMP; E. G. K. Anderson, Chicago, Ill. App. filed Aug. 29, 1913. For dental and surgical uses, being provided with a transparent tubular shield throughout substantially the entire length of the lamp.

1,122,863. ELECTRICAL CONDUCTOR; Palmer Clingman, New York, N. Y. App. filed June 29, 1914. Arrangement of section insulator in a high-tension railway circuit.

1,122,892. ELECTRIC-HEATING APPARATUS; Dudley Farrand, Newark, N. J. App. filed March 16, 1910. The fluid to be heated is passed through coils forming the secondary of a transformer.

1,122,931. MOTOR CONTROLLER; A. J. Horton, White Plains, N. Y. App. filed Nov. 22, 1913. Use is made of two push buttons for starting and stopping the motor for limited or continuous operation.

1,122,942. ELECTRIC SYSTEM FOR TRANSMITTING ANGULAR POSITIONS; Paul Kaminski, Nonnendamm, near Berlin, Germany. App. filed Aug. 15, 1913. A sending element for fine adjustment and a sending element for coarse adjustment, with corresponding receiving elements controlling electric motors between which a differential gear is interposed.

1,122,962. ELECTRICALLY OPERATED DROP HAMMER; John D. MacDonald, Pittsburgh, Pa. App. filed June 4, 1913. The ram head is reciprocated electrically, the movement being controlled both manually and automatically.

1,122,975. SYSTEM FOR GENERATING ELECTRIC CURRENTS OF HIGH FREQUENCY; Thomas B. Miller, Seattle, Wash. App. filed Nov. 16, 1912. Means for controlling the magnetic leakage in transformers employed in wireless-telegraph systems.

1,122,980. DYNAMO-ELECTRIC MACHINE; Soren H. Mortensen, Milwaukee, Wis. App. filed Sept. 16, 1909. Supports for the collector leads.

1,123,002. SEPARABLE ATTACHMENT PLUG; Clarence D. Platt, Bridgeport, Conn. App. filed July 25, 1913. Mechanical details.

1,123,085. COIL SUPPORT; Arthur J. Brown and Robert B. Williamson, Milwaukee, Wis. App. filed Sept. 6, 1910. Means for supporting the end turns of stator coils.

1,123,098. SYSTEM OF DISTRIBUTION FOR OSCILLATORY ELECTRICAL CURRENTS; Louis Cohen, Cambridge, Mass. App. filed Dec. 14, 1912. Comprises a tuned antenna circuit, a second tuned circuit and an independent condenser of relatively small capacity to the tuning capacity.

1,123,118. SIGNALING SYSTEM; Lee DeForest, New York, N. Y. App. filed July 8, 1907. A carbon arc electrode arranged in a high-frequency oscillation circuit has a solid body forming a core of hydrocarbon material.

1,123,119. SECRECY SYSTEM FOR WIRELESS COMMUNICATION; Lee DeForest, New York, N. Y. App. filed July 8, 1907. Means are employed to convert received oscillations into low-frequency currents at the receiving station.

1,123,120. ARC MECHANISM FOR SYSTEMS OF SPACE COMMUNICATIONS; Lee DeForest, New York, N. Y. App. filed Jan. 20, 1909. For combination with arc electrodes having an air space between their proximate portions of means for causing a continuous flow of liquid to the air space between the electrodes.

1,123,147. INSTRUMENT FOR MAGNETICALLY RECORDING SOUND VIBRATIONS; John C. Sherman, Brookline, Mass. App. filed Nov. 21, 1908. A recording wire passes between the pole-pieces of magnets.

1,123,161. DYNAMO-ELECTRIC MACHINE; Ernest J. Andrews, Chicago, Ill. App. filed July 5, 1907. The armature is provided with a plurality of normally open inductive coils permanently connected to a commutator associated with a circuit changer for placing them in series or in parallel.

1,123,187. ATTACHMENT PLUG; Henry R. Gilson, Baden, Pa. App. filed June 27, 1913. Mechanical details of a floor plug.